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(54) **APPARATUS AND METHOD FOR CUTTING AND/OR CRIMPING WRAPPING MATERIAL**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

4,730,436 A 3/1988 Angelino
5,140,800 A 8/1992 Martin et al.
(Continued)

FOREIGN PATENT DOCUMENTS

EP 1911567 A1 4/2008
GB 486 947 A 6/1938
(Continued)

OTHER PUBLICATIONS

International Search Report for PCT/GB2014/053293 dated Jan. 21, 2015, 13 pages.
(Continued)

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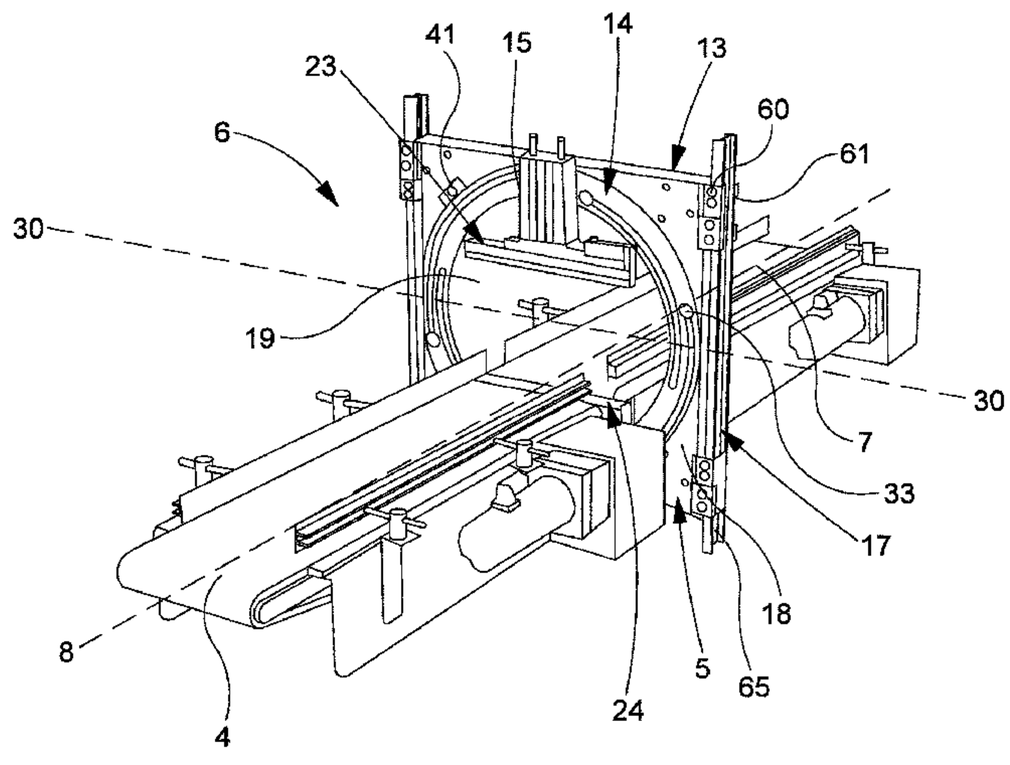
(57) **ABSTRACT**

A cutting, or crimping, apparatus having first and second opposed jaw members which are mounted on a frame and are movable relative to each other from a first axial position to a second axial position along an axis so as to respectively cut, or crimp, wrapping material extending between adjacent articles wherein at least one of the jaw members is rotatably mounted to the frame such that it is rotatable from a first rotational position to a second rotational position, in the first rotational position the jaw members are movable relative to each other along a first said axis and in the second rotational position the jaw members are movable relative to each other along a second said axis that is inclined relative to the first axis.

19 Claims, 16 Drawing Sheets



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B29C 65/78	(2006.01)
B29C 65/02	(2006.01)
B29C 65/74	(2006.01)
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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,531,061	A	7/1996	Peterson
2002/0178691	A1	12/2002	Liao
2007/0209323	A1	9/2007	Honegger
2008/0072537	A1	3/2008	Hashimoto et al.
2008/0184676	A1	8/2008	Downhill

FOREIGN PATENT DOCUMENTS

GB	2221868	A	6/1989	
WO	2007/135088	A1	11/2007	
WO	WO-2007135088	A1 *	11/2007	..... B65B 9/06

OTHER PUBLICATIONS

Great Britain Search Report for GB 1319532.6 dated Jan. 13, 2014, 4 pages.

* cited by examiner

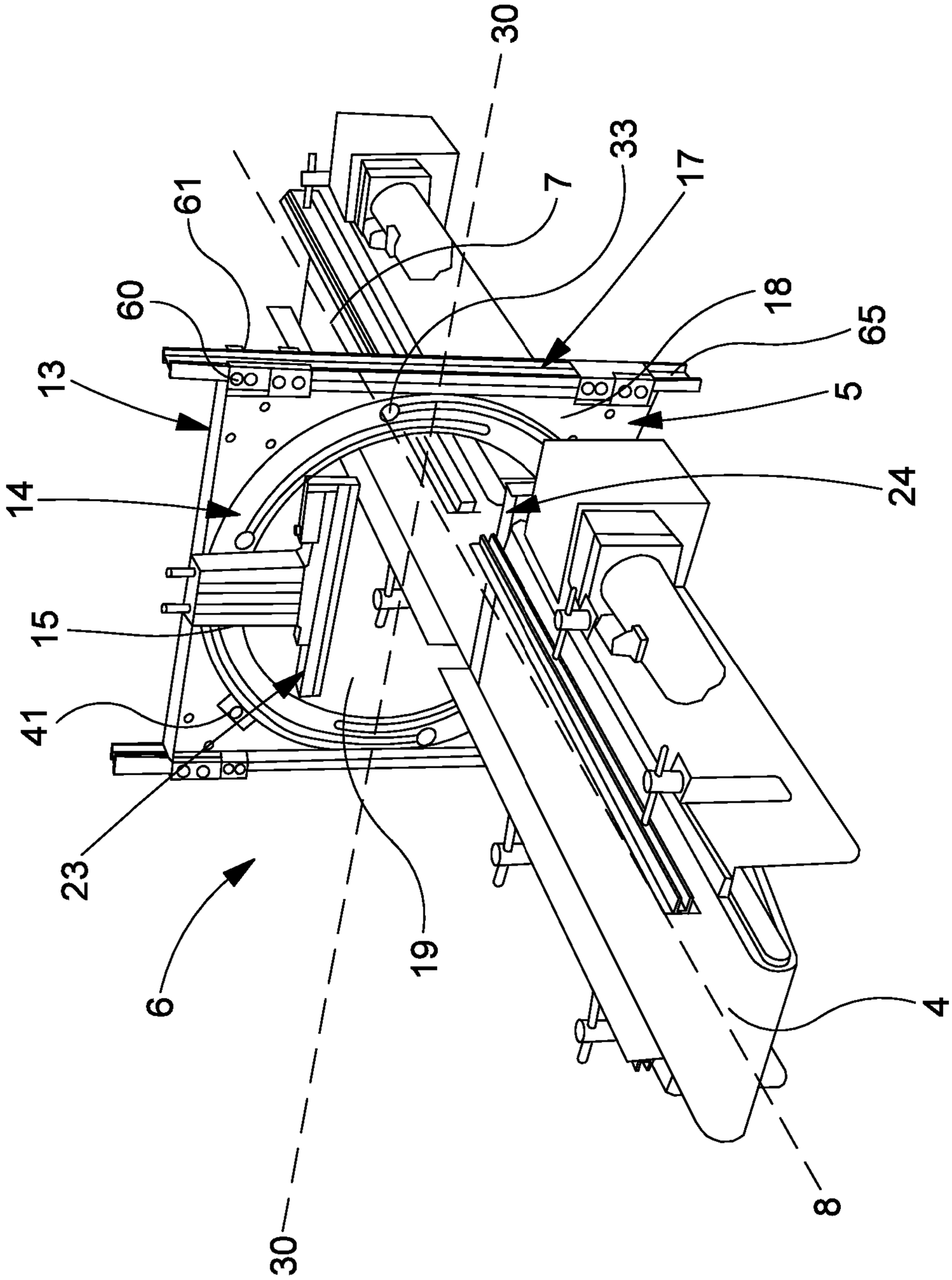


Fig. 1

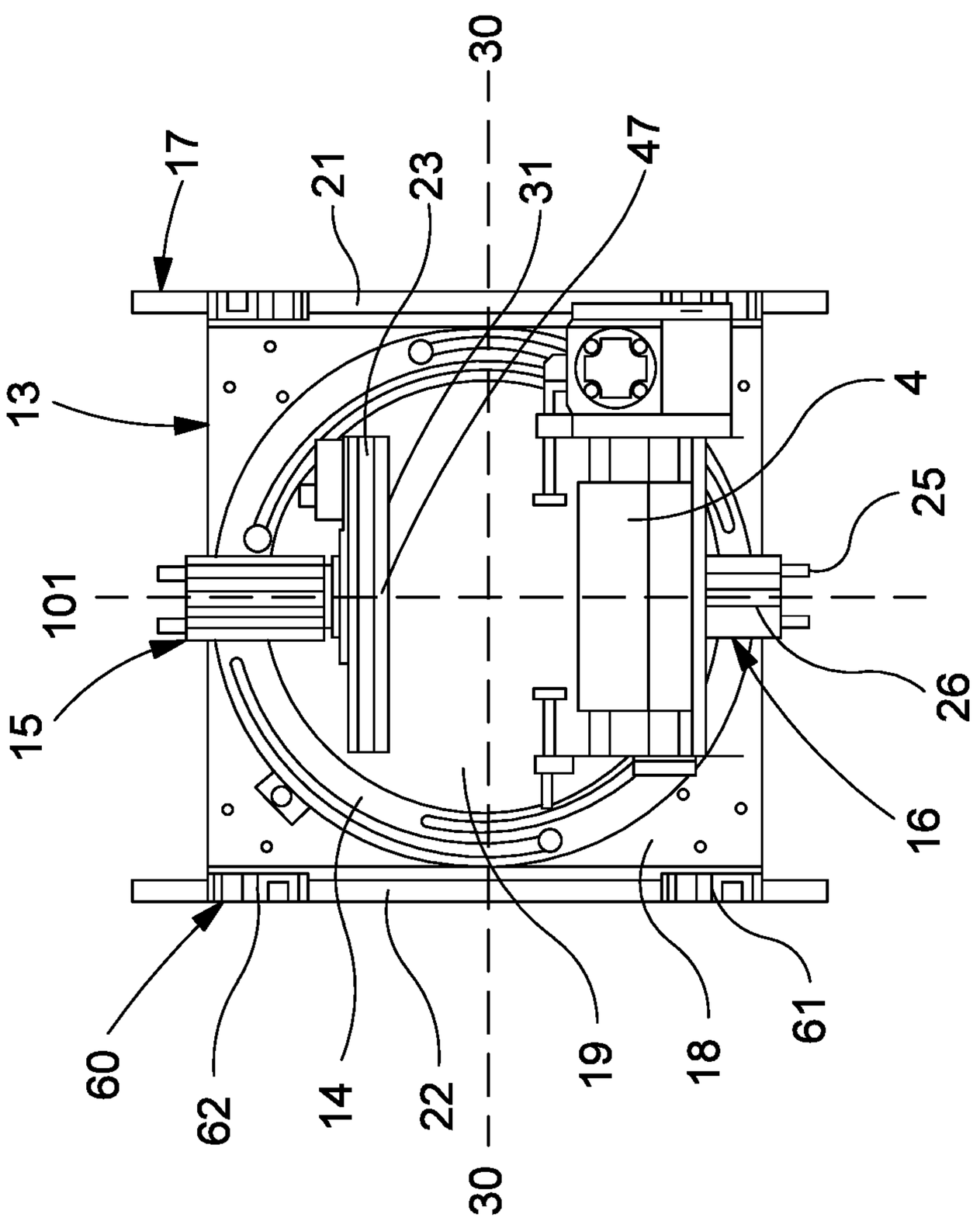


Fig. 2

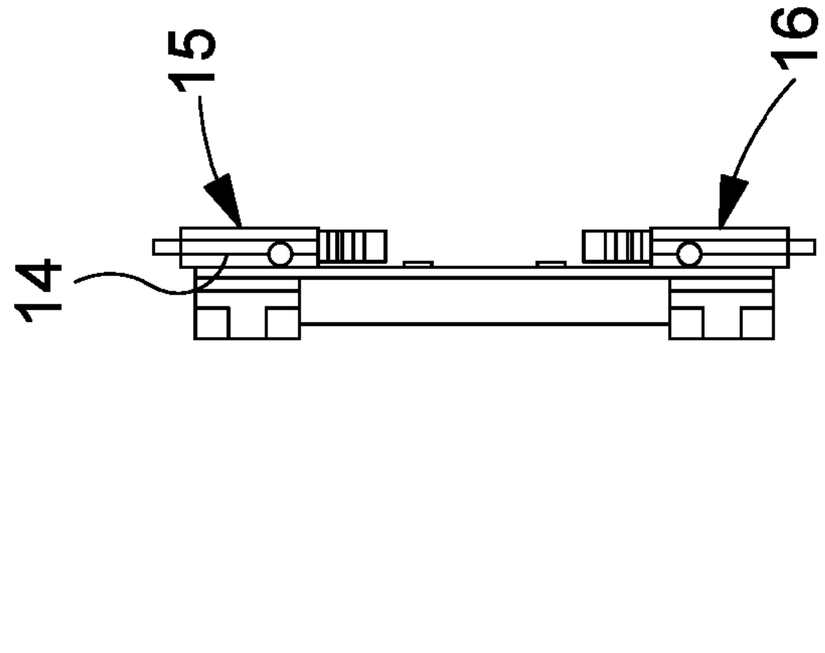


Fig. 4

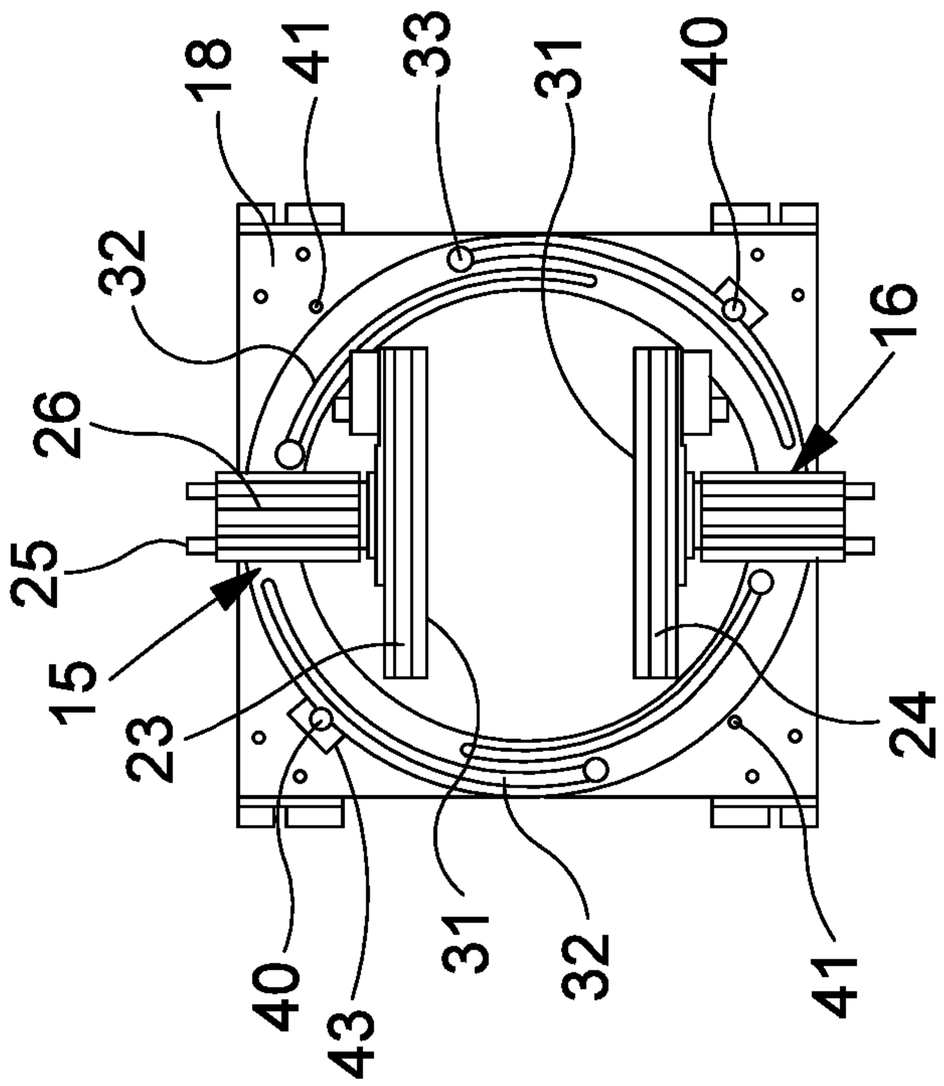


Fig. 3

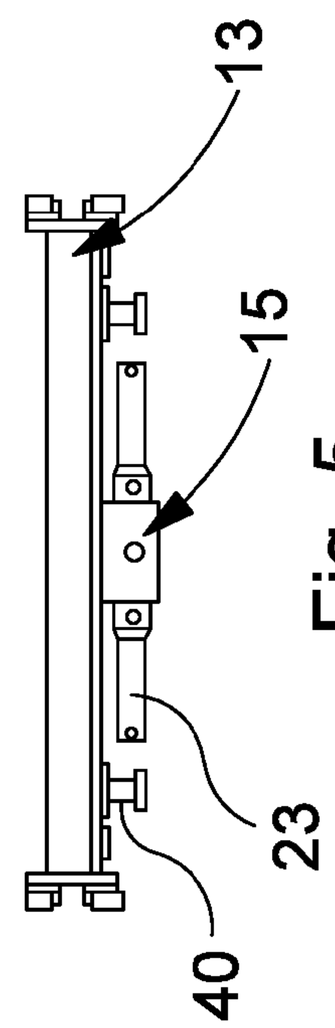
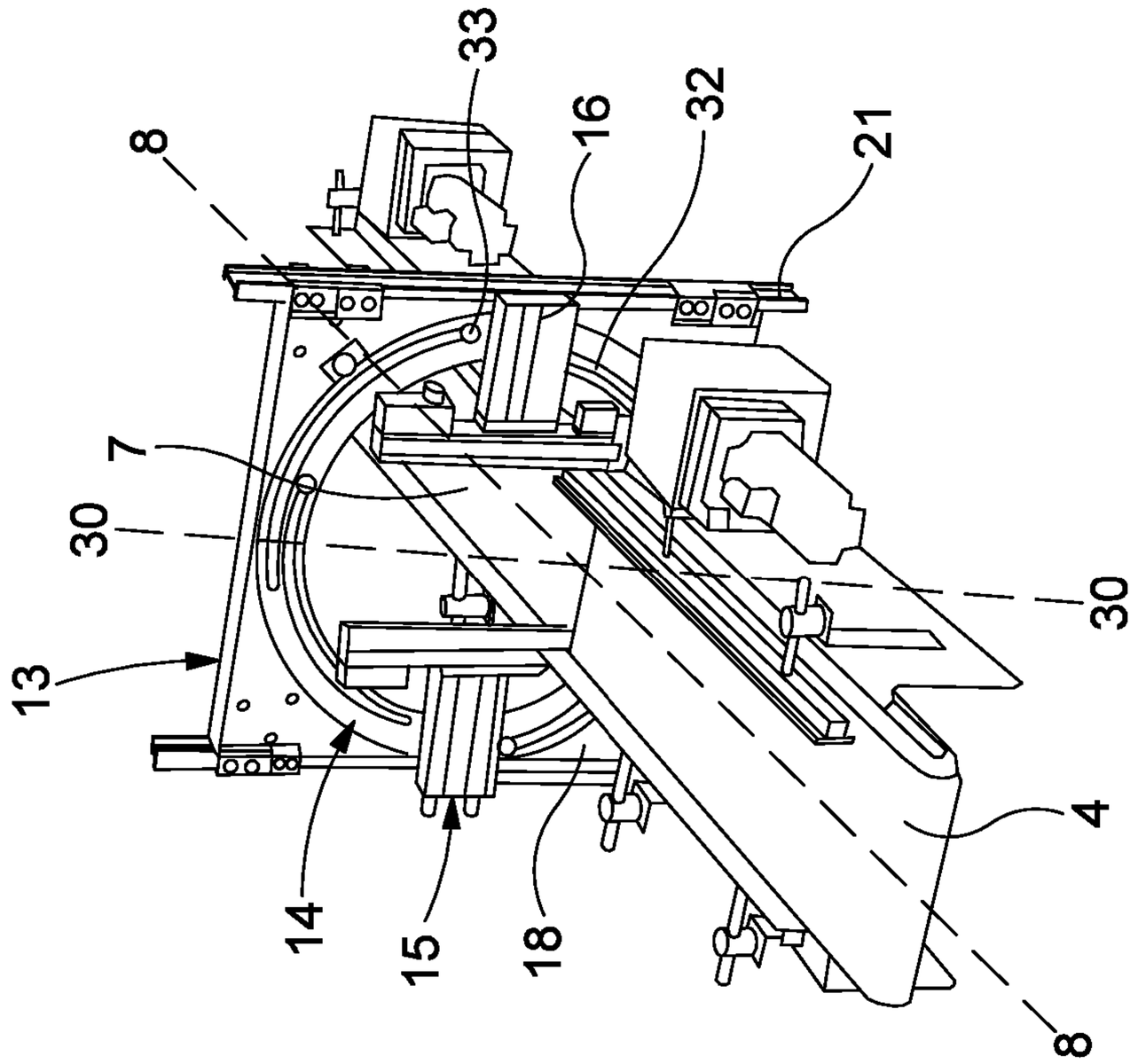


Fig. 5



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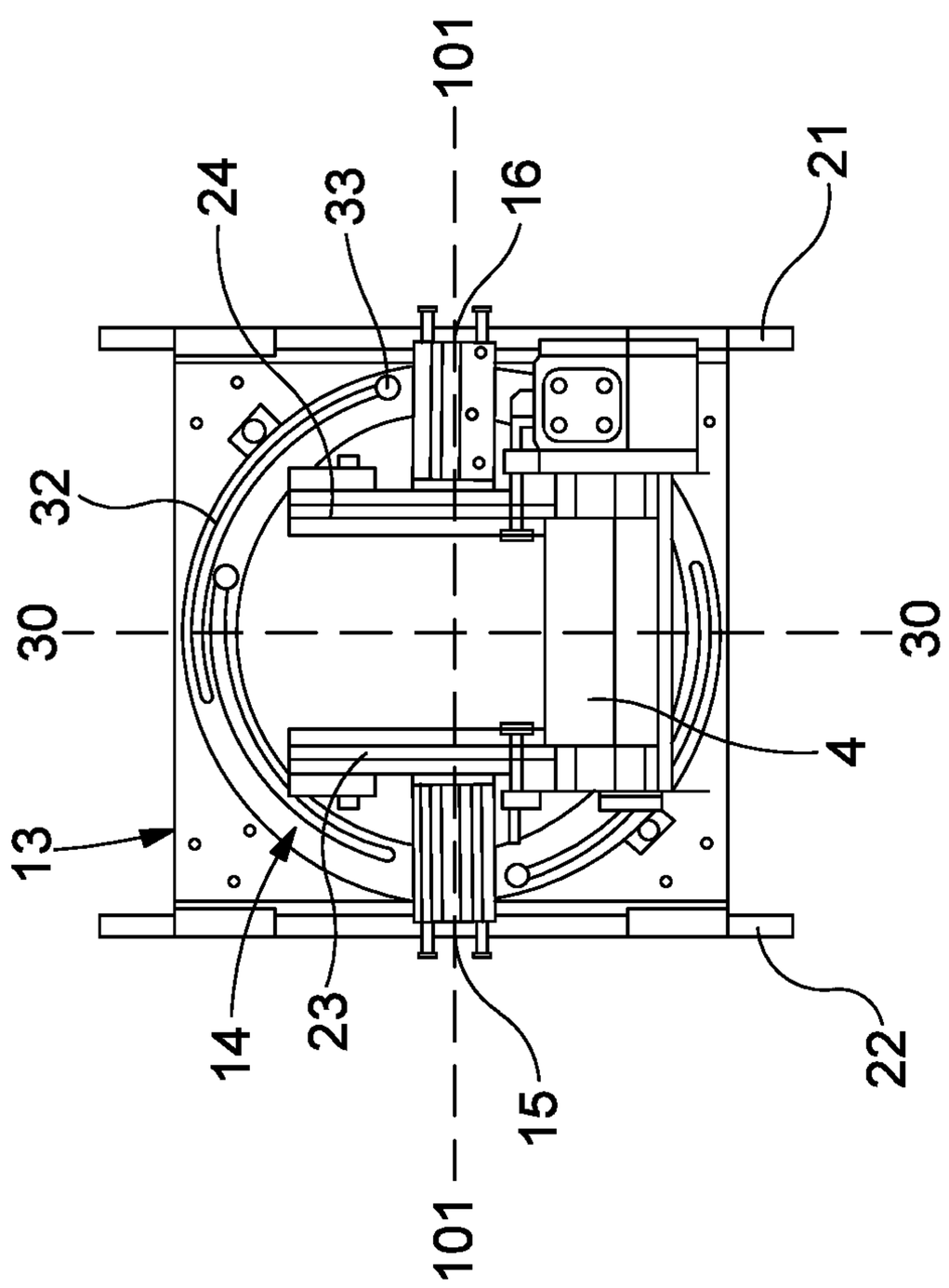

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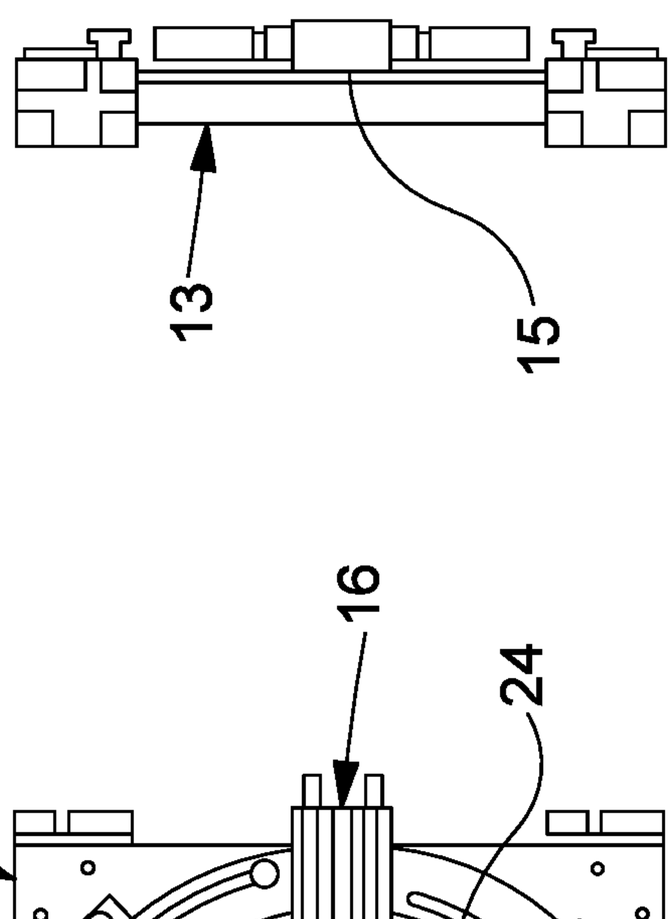


Fig. 8

Fig. 9

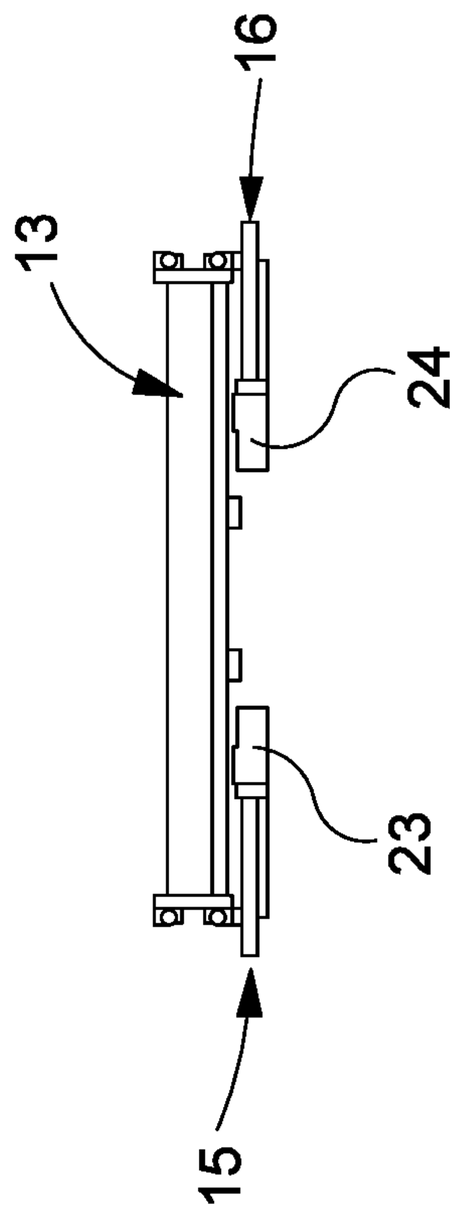
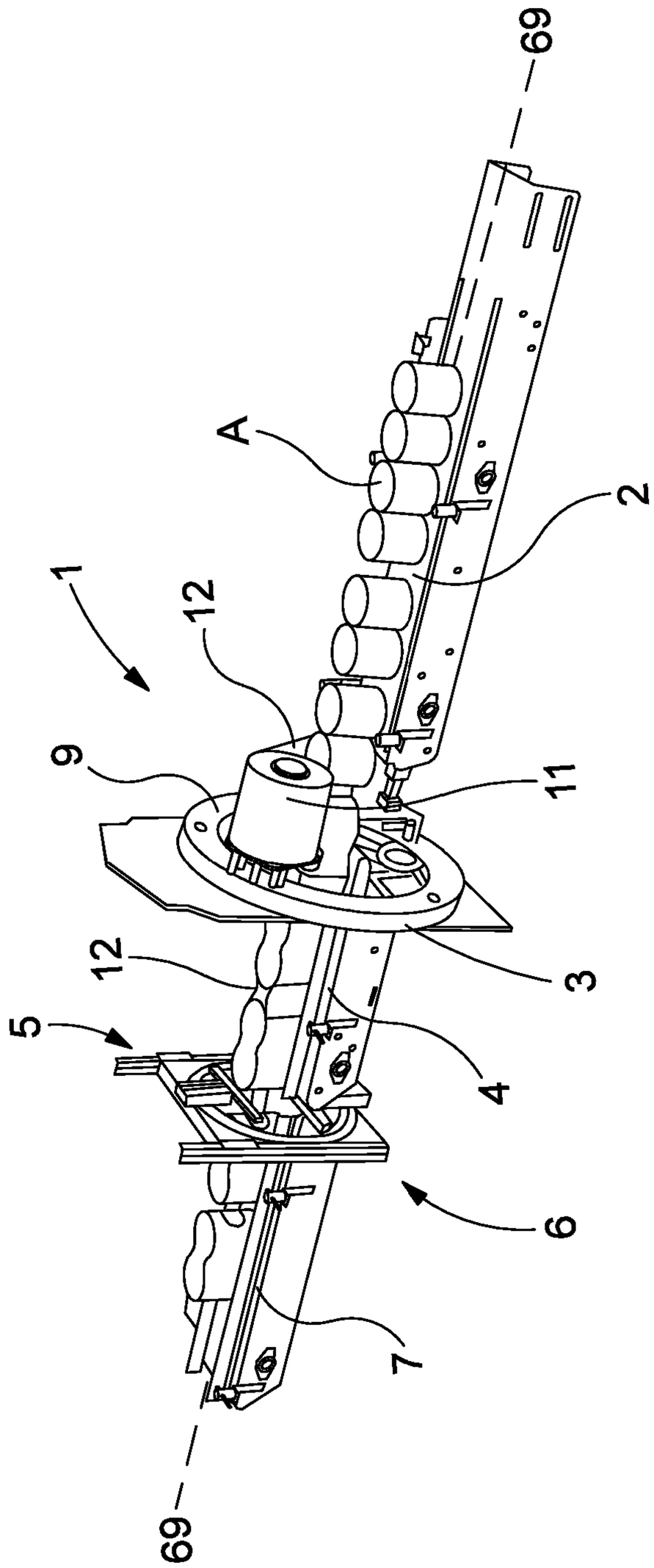


Fig. 10



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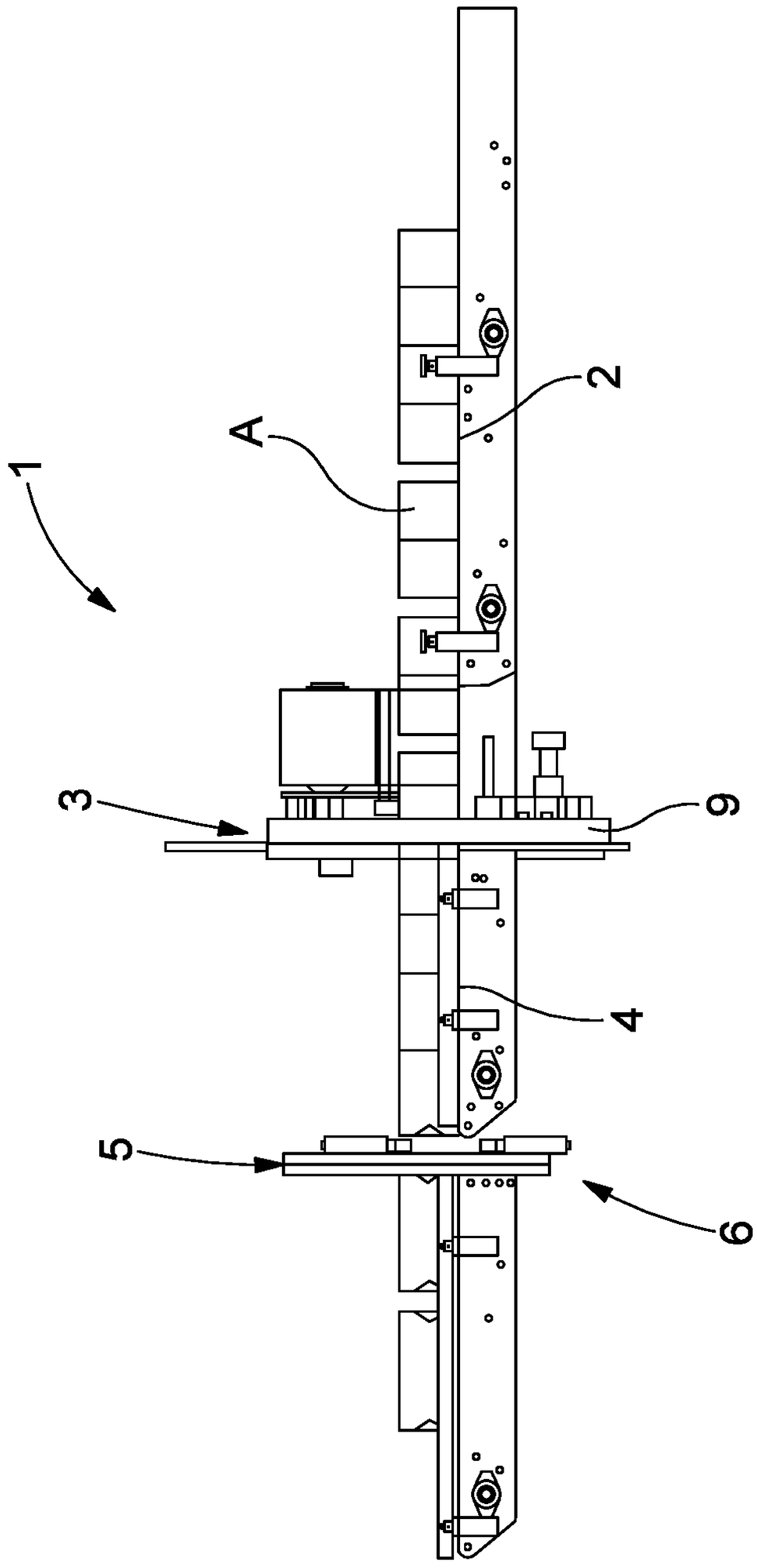
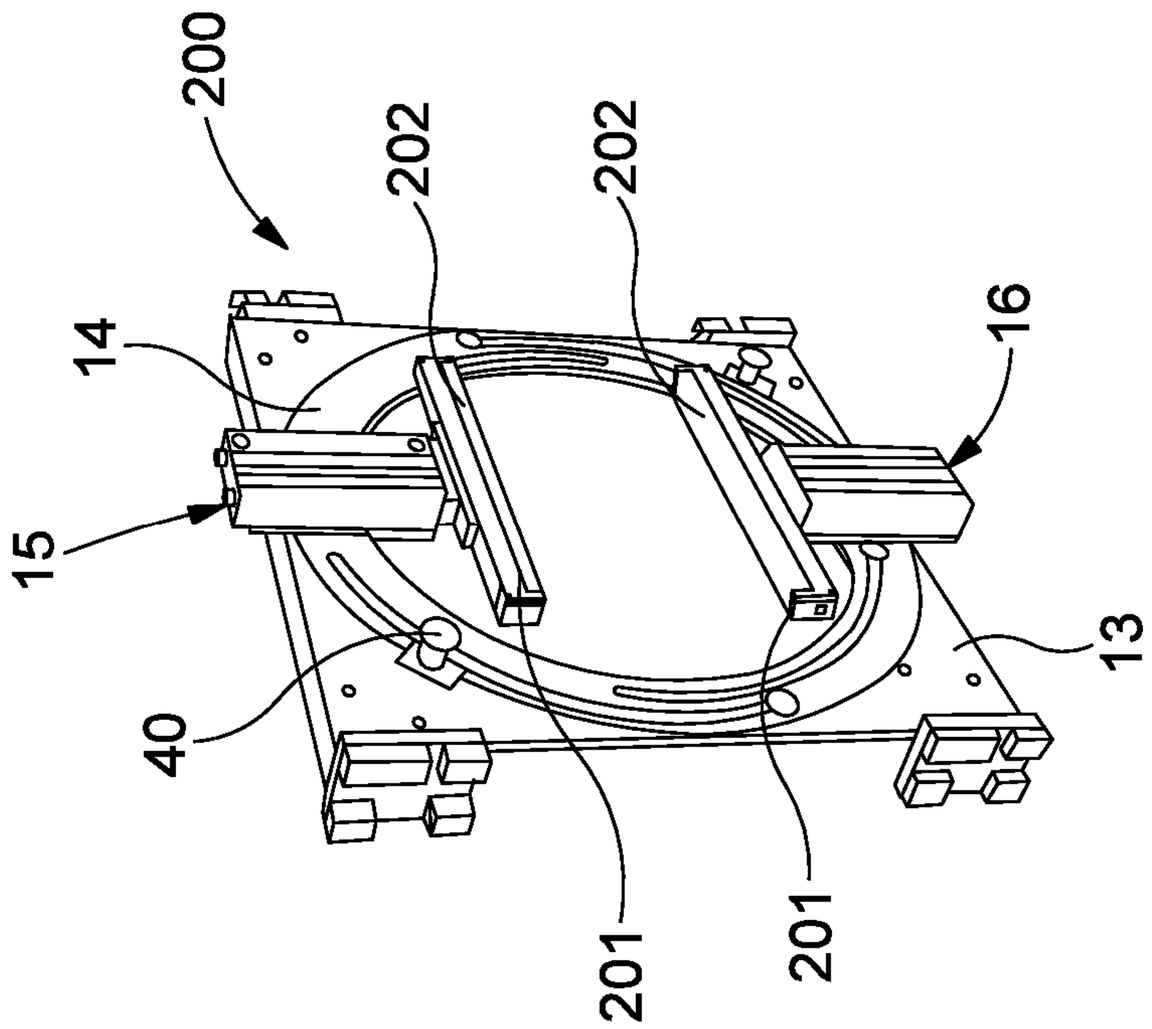


Fig. 12



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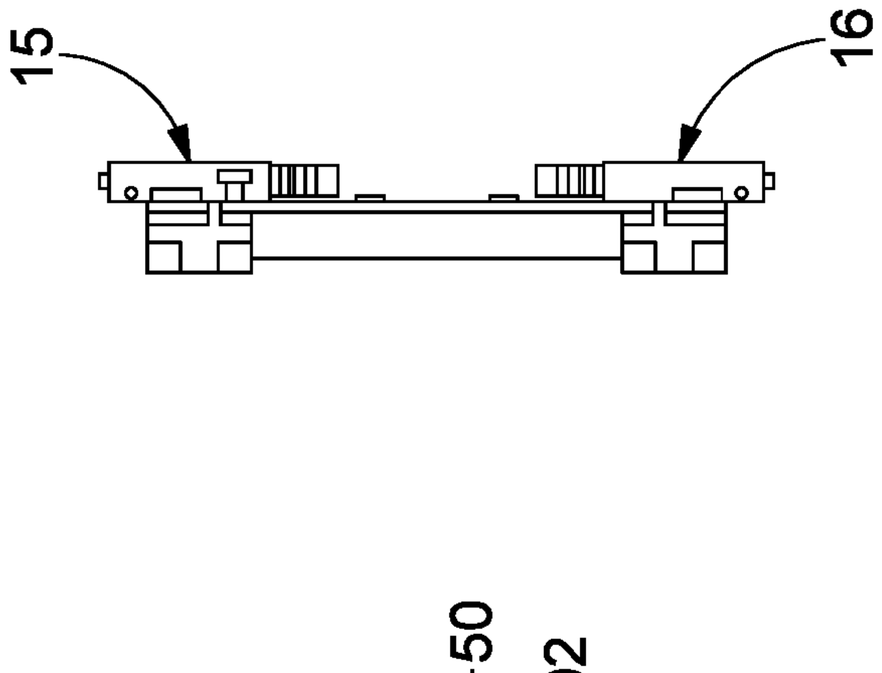

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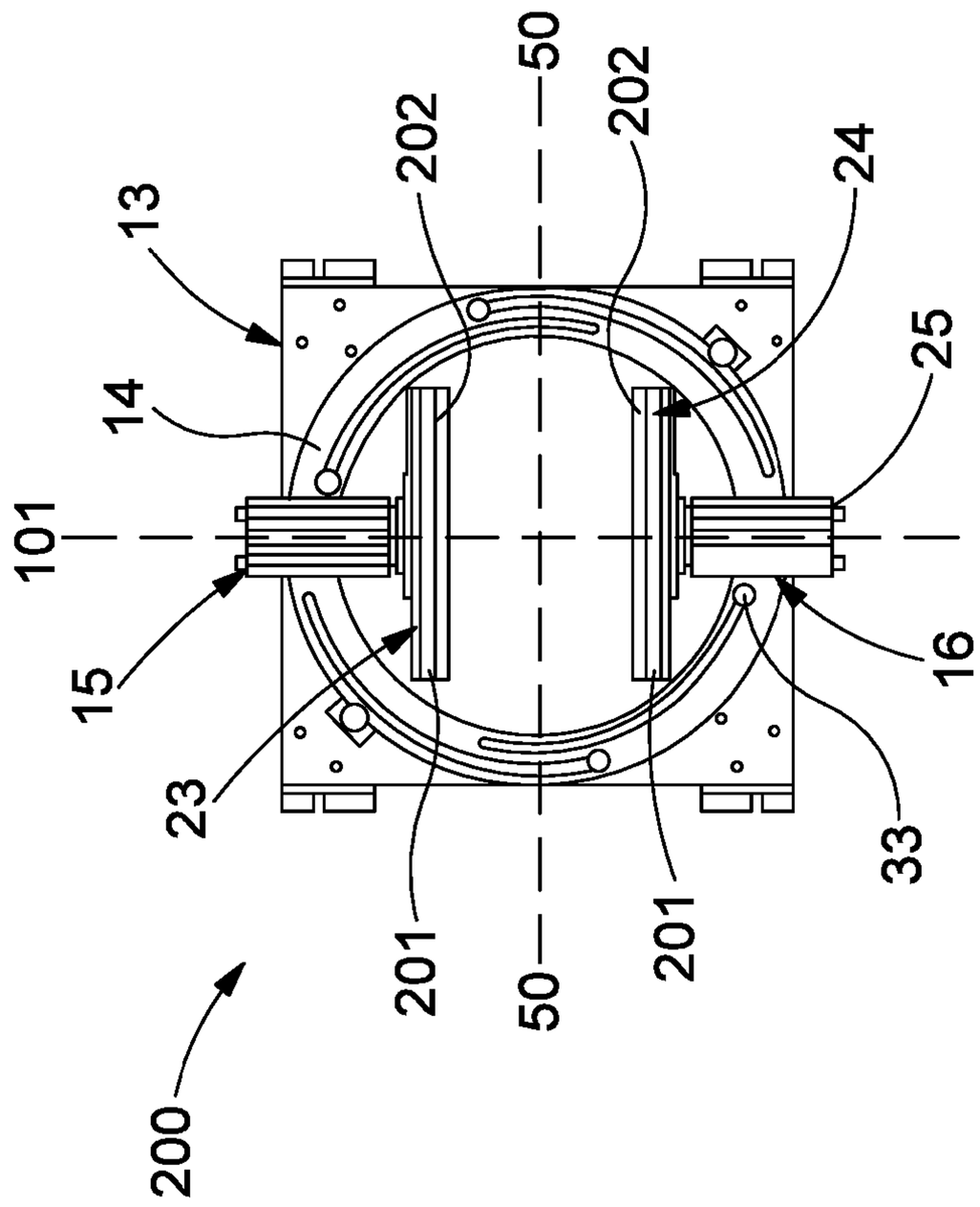

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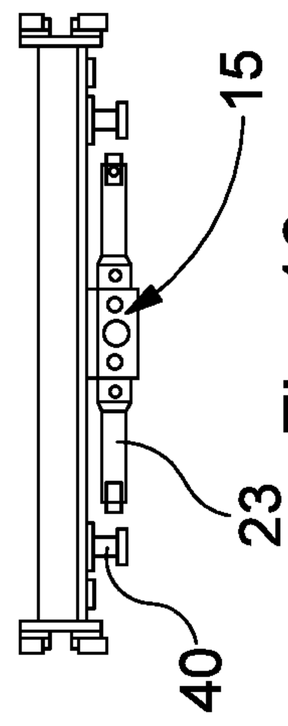

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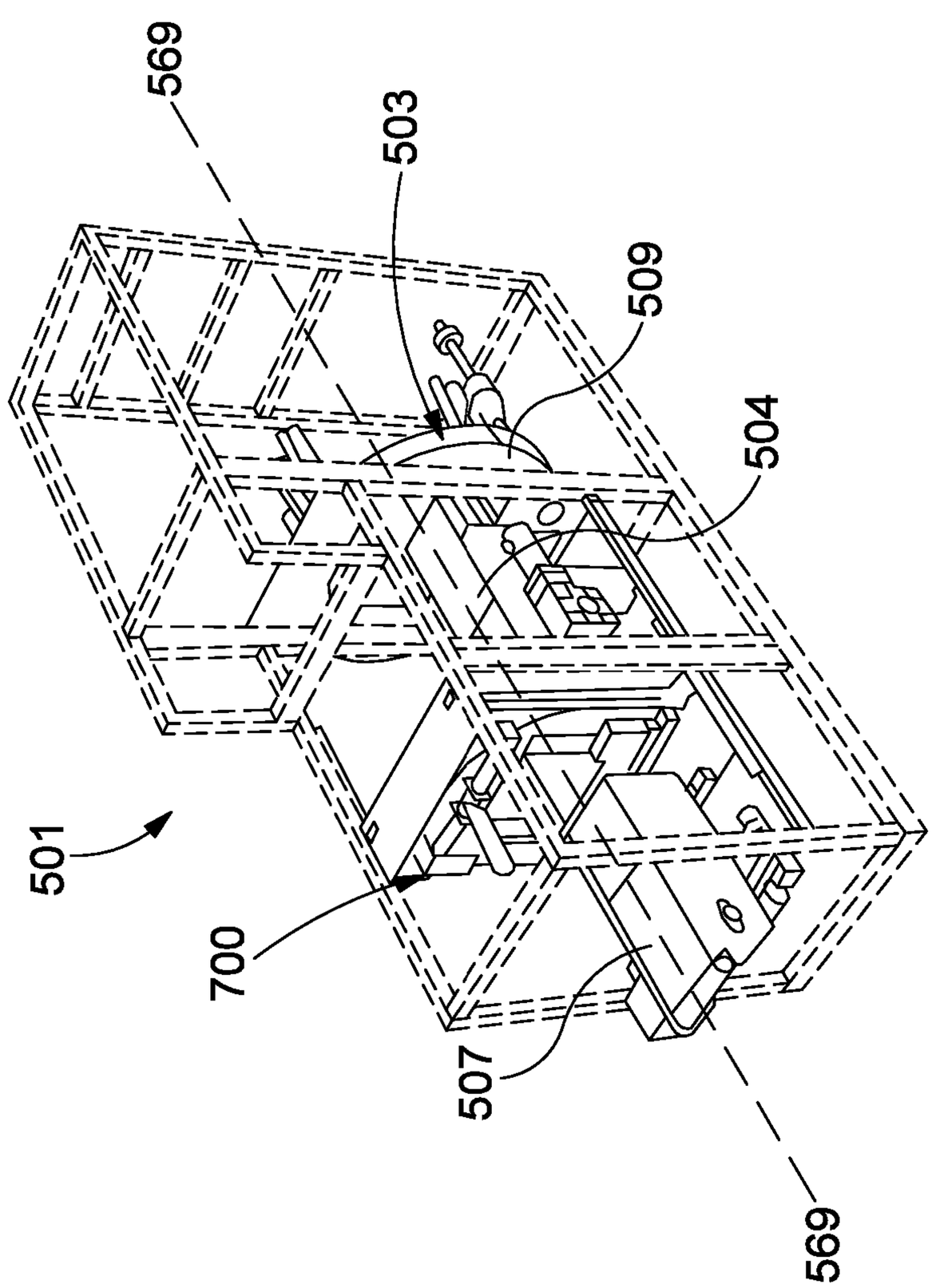

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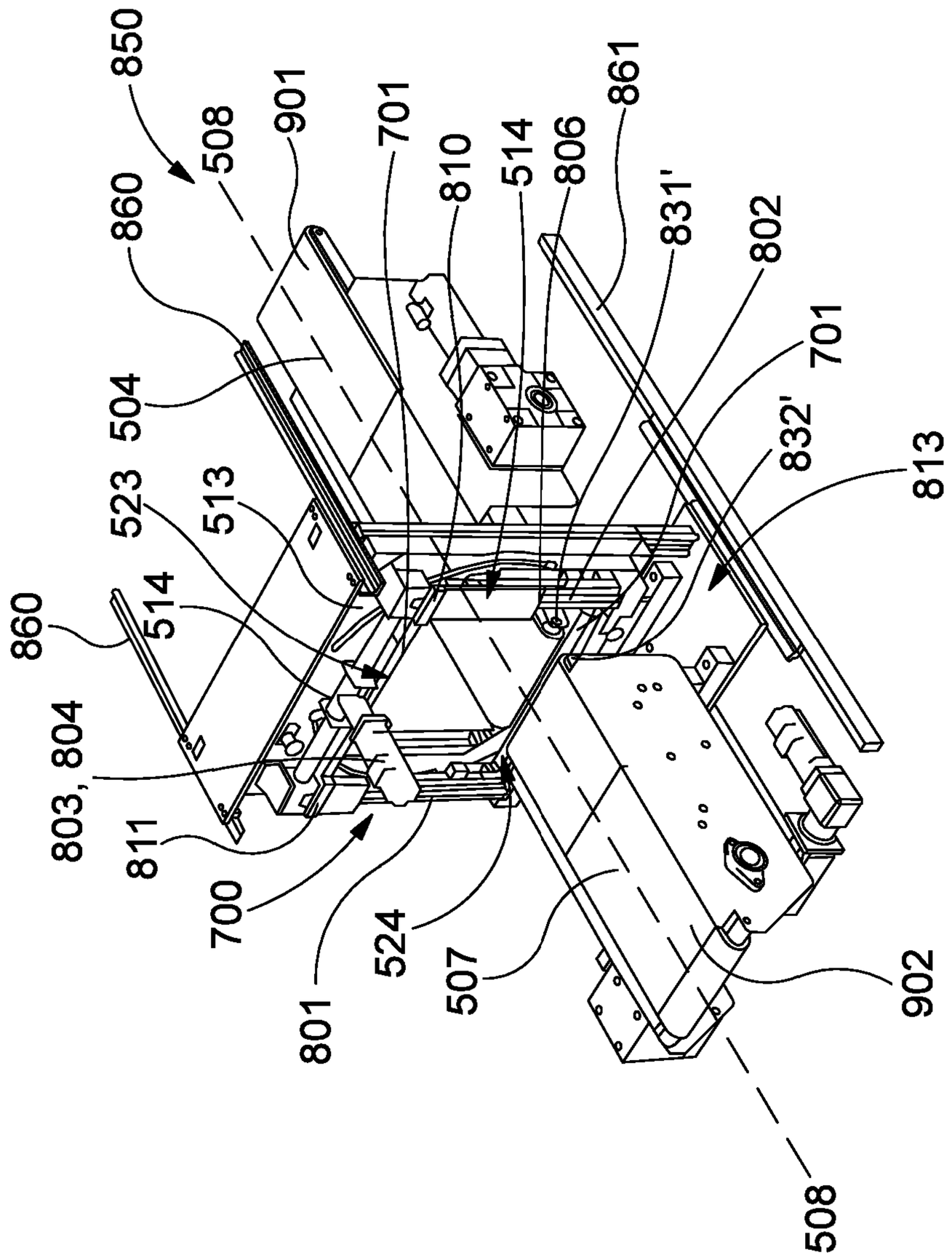
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Fig. 18

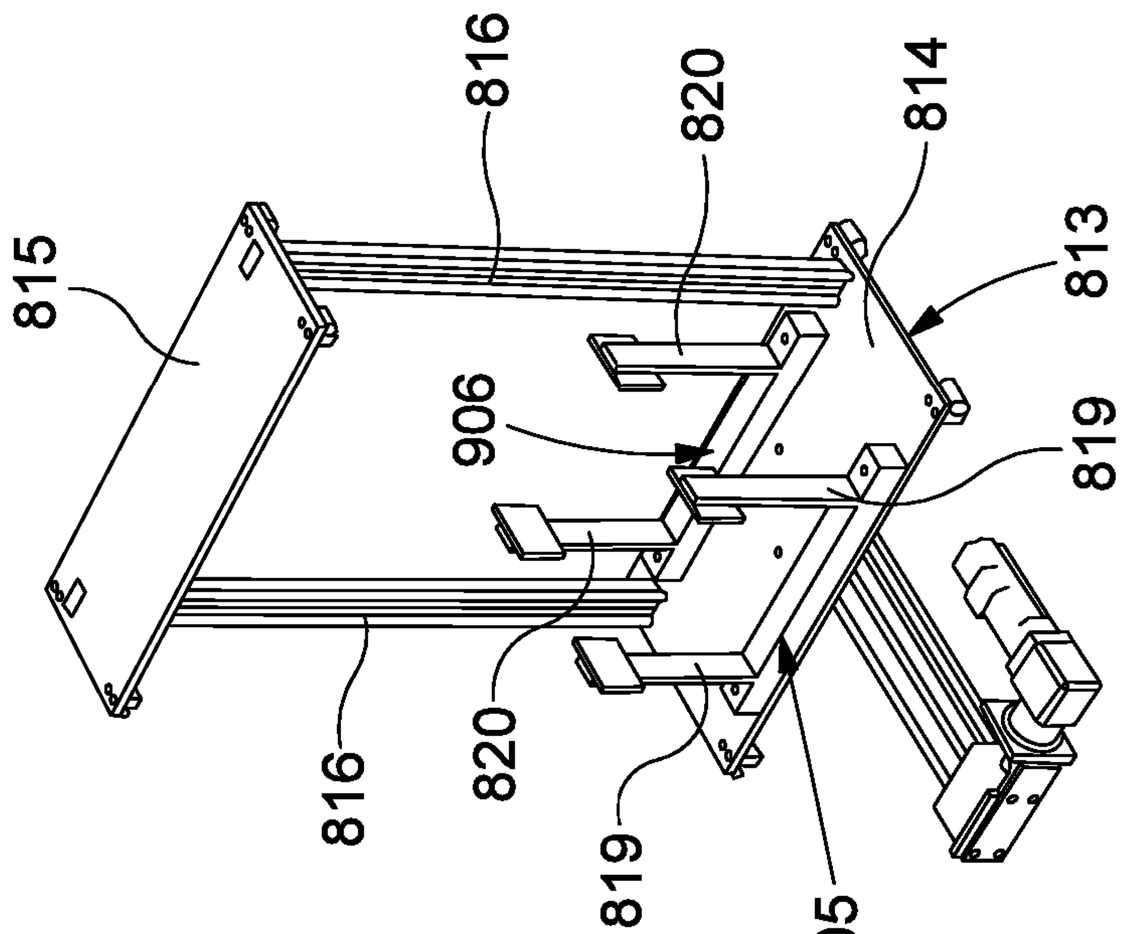

Fig. 19

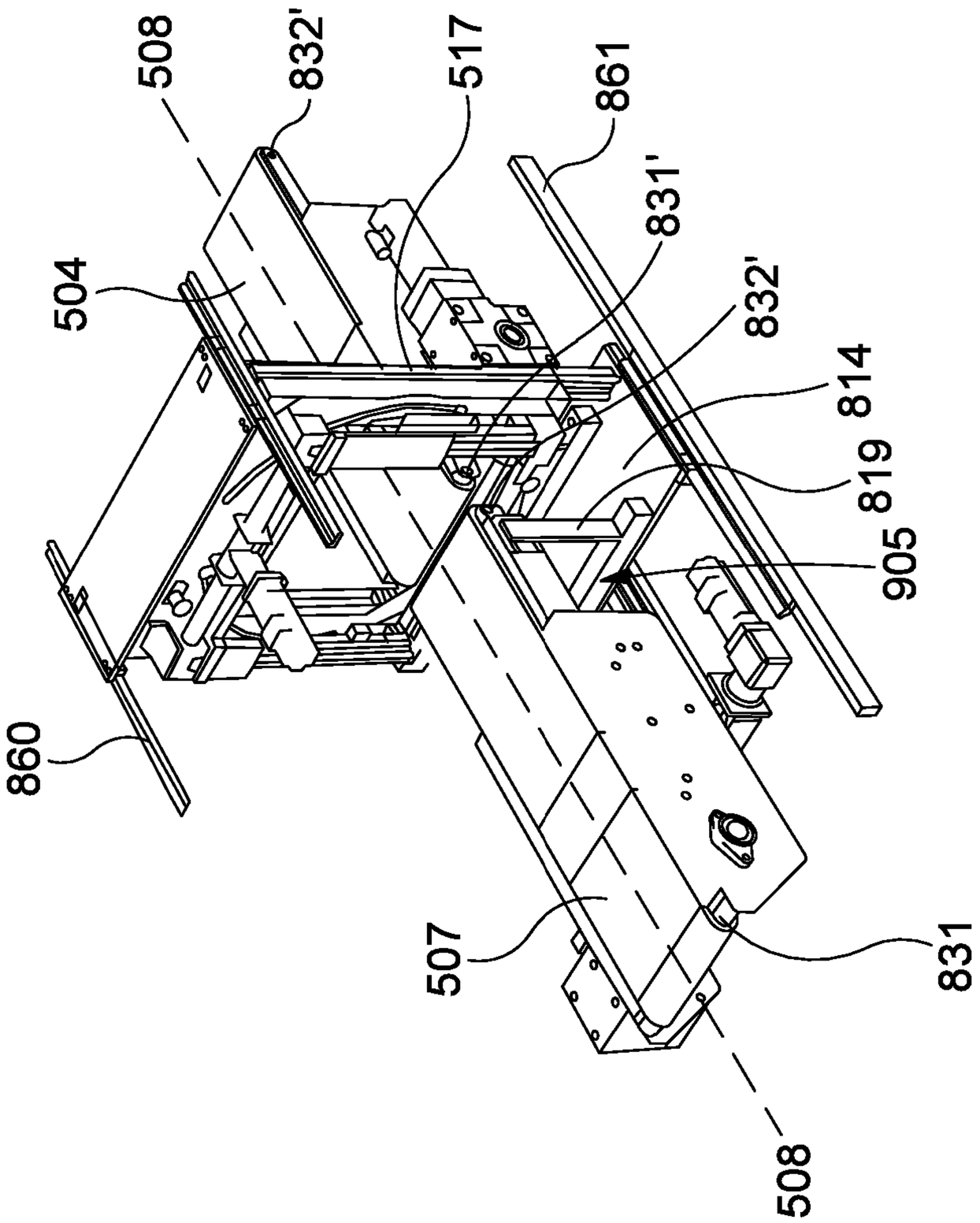

Fig. 20

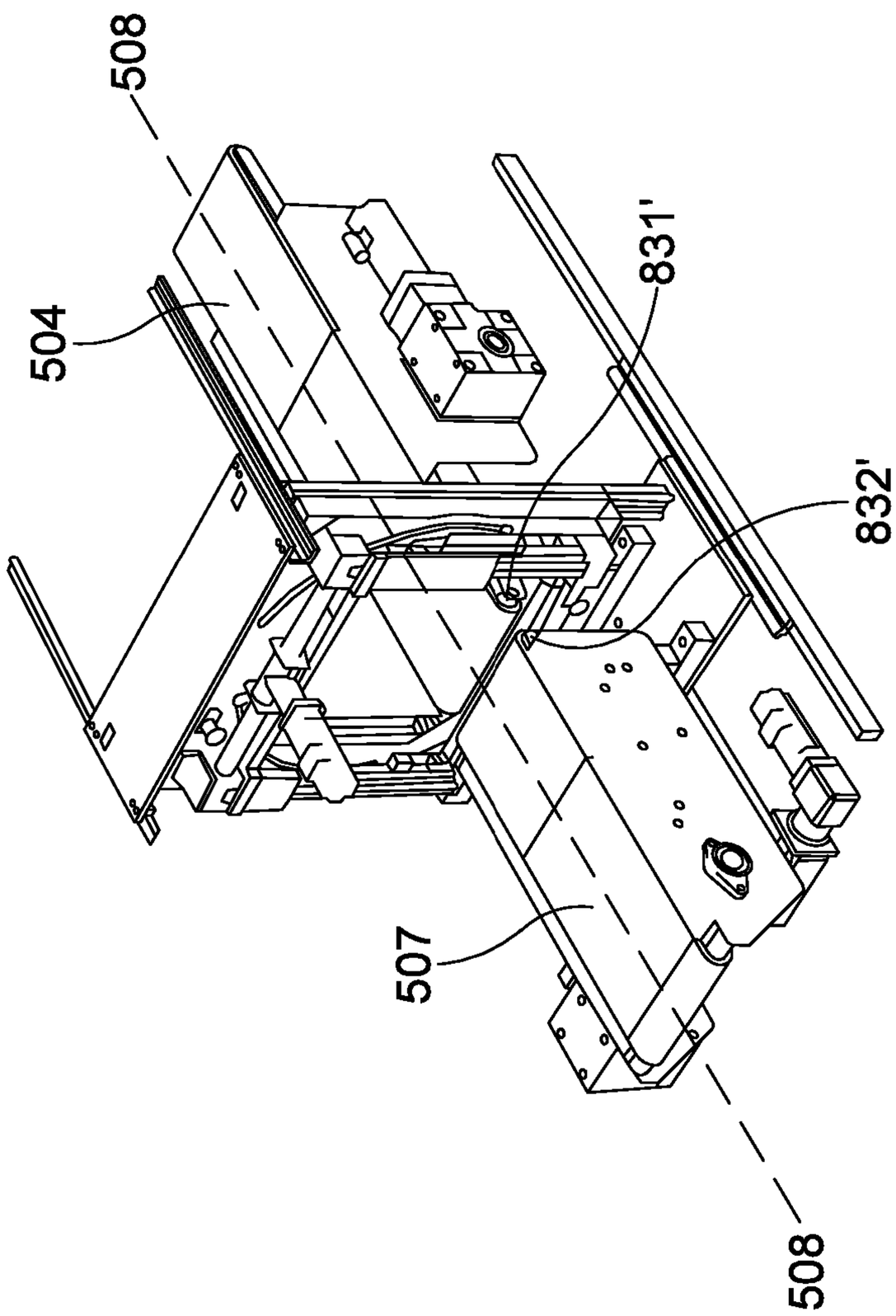

Fig. 21

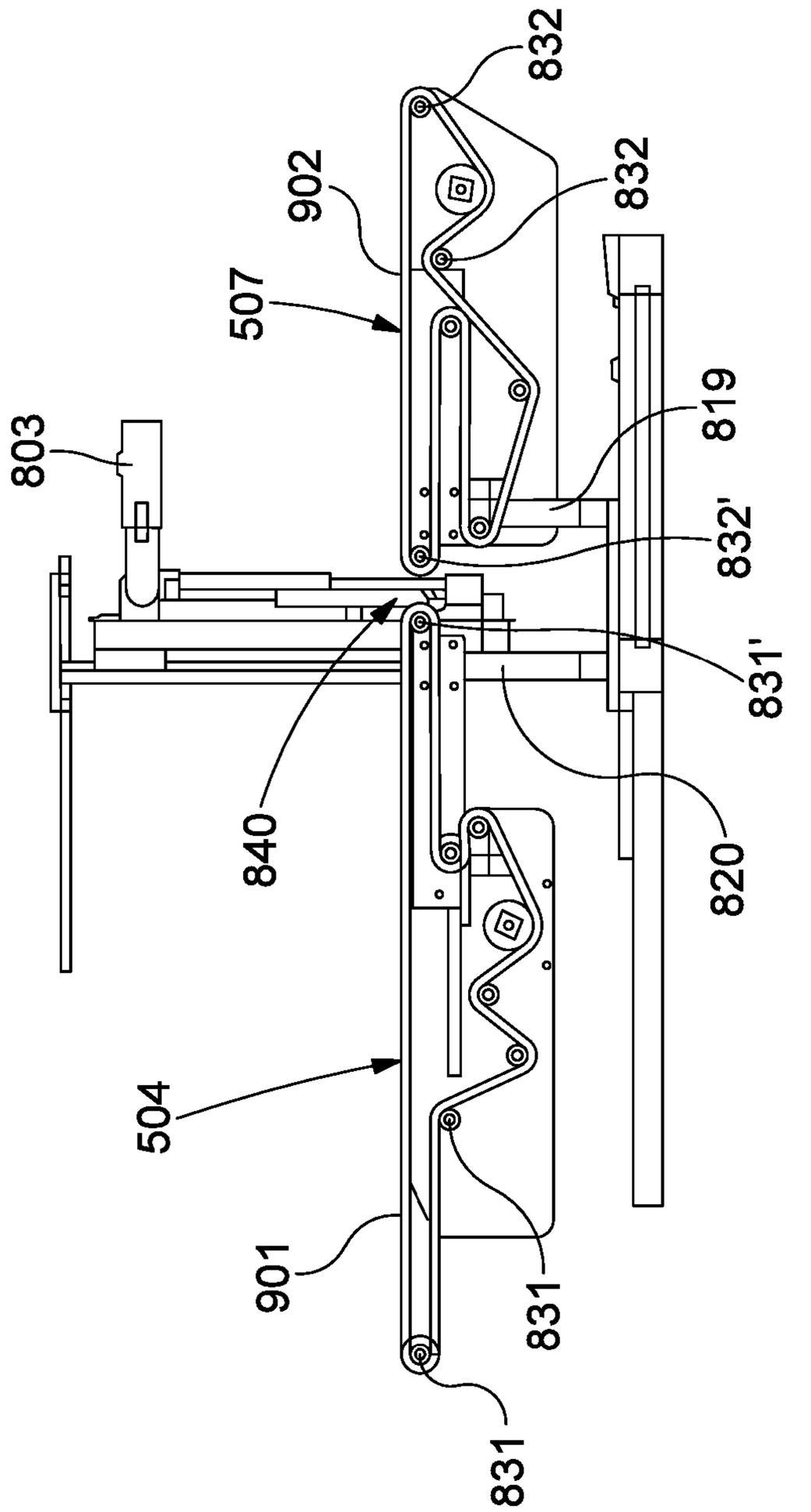

Fig. 22

APPARATUS AND METHOD FOR CUTTING AND/OR CRIMPING WRAPPING MATERIAL

The present invention relates to an apparatus and assembly for, and method of, cutting and/or crimping wrapping material extending between articles, or collations of articles, in a production line environment. The present invention also relates to a packaging apparatus and method.

It is known to package articles by wrapping them in flexible sheet material such as, for example, highly stretched synthetic plastic film. An article, or a collation of articles, is typically enclosed between two sheets of material or a folded single sheet and the material is heat sealed at overlapping edges.

In a known helical wrapping machine articles are wrapped by winding a continuous web of wrapping material around the articles in a direction generally transverse to their direction of movement along the machine. This results in the articles being wrapped by a helical continuous web of material. The machine has an upstream conveyor that is separated from a downstream conveyor by a rotary ring-type web applicator whose rotary axis is generally parallel to the longitudinal axis of the conveyors.

As the collations of articles pass through the applicator, its ring rotates at a predetermined speed and dispenses the wrapping material. As a result, the articles are wrapped by a continuous helical band of material. The wrapped articles pass to the downstream conveyor which carries them to a cutting station. At the cutting station, the wrapped collations of articles are separated into individually wrapped collations of articles by cutting through the adjoining wrapping between each collation. The cutting station comprises a pair of opposed parallel cutting jaw members that are movable towards each other to cut the adjoining wrapping between each collation.

If it is desired to seal the wrapping at each end of the separated wrapped collations, the collations of articles are passed to a crimping station. At the crimping station the ends of the wrapping that extends around each collation are crimped by the crimping station, so as to seal ends of the wrapping together. The crimping station comprises a pair of opposed parallel crimping jaw members that are movable towards each other to crimp the wrapping at each end, so as to seal the wrapping at each end.

However, the applicant has identified that it can be sub-optimal to use the same configuration of cutting/crimping apparatus to cut/crimp articles of different shapes and sizes.

Accordingly, it is an object of the present invention to obviate or mitigate at least some of the problems which are apparent from the above.

According to a first aspect of the present invention there is provided a cutting, or crimping, apparatus comprising first and second opposed jaw members which are mounted on a frame and are movable relative to each other from a first axial position to a second axial position along an axis so as to respectively cut, or crimp, wrapping material extending between adjacent articles wherein at least one of the jaw members is rotatably mounted to the frame such that it is rotatable from a first rotational position to a second rotational position, in the first rotational position the jaw members are movable relative to each other along a first said axis and in the second rotational position the jaw members are movable relative to each other along a second said axis that is inclined relative to the first axis.

The applicant has identified that it is desirable to change the direction of axial movement of the jaw members, from their first axial position to their second axial position, depending on the dimensions and orientation of the articles. For example, if the articles carried on a conveyor to the cutting or crimping apparatus are relatively tall and narrow, the applicant has identified that it is preferable that the axial direction of movement of the jaw members is substantially horizontal. Conversely, if the articles are relatively short and wide the applicant has identified that it is preferable that the axial direction of movement of the jaw members is substantially vertical.

Orienting the axial direction of movement of the jaw members in this manner is advantageous in that it shortens the distance that the opposed jaw members need to travel in order to cut, or crimp, wrapping material extending between adjacent articles, thereby reducing the length of wrapping material that the jaw members need to cut or crimp through. In this respect, the length of wrapping material that each point on the jaw member has to cut or crimp through is reduced. This reduces the energy that is lost as heat during the cutting or crimping, thereby resulting in a more efficient cutting, or crimping, apparatus.

In addition, this change of orientation may be done quickly and easily. In this respect, it is not necessary to remove a cutting, or crimping, apparatus that has a first (e.g. horizontal or vertical) orientation of said axial direction of movement of the jaw members and to replace it with a separate cutting, or crimping, apparatus that has a second (e.g. vertical or horizontal) orientation of said axial direction. This therefore saves time and cost. In this respect, since the productivity of a production line apparatus is highly dependent on the number of articles that are wrapped per unit time, any stoppages in a production line result in a significant economic loss. In addition, costs are saved as it is not necessary to providing separate cutting, or crimping apparatuses with different jaw orientations and as it is not necessary to employ skilled personnel in order to change the cutting, or crimping, apparatus.

The at least one jaw member may rotate from its first rotational position to its second rotational position about an external rotational axis, i.e. about a rotational axis external of the jaw member. In this respect, the at least one jaw member may revolve about the rotational axis as it rotates from its first rotational position to its second rotational position. As it revolves it may not rotate about an internal axis.

As the at least one jaw member rotates from its first rotational position to its second rotational position it may also translate relative to the frame.

The at least one jaw member may be one of the jaw members. In this case, only one of the jaw members may rotate from the first rotational position to the second rotational position, relative to the frame. Alternatively, the at least one jaw member may be both of the jaw members. In this case, both the jaw members may rotate from the first rotational position to the second rotational position, relative to the frame.

Where the at least one jaw member is one of the jaw members, as this jaw member rotates relative to the frame, from its first rotational position to its second rotational position, it may rotate and/or translate relative to the other jaw member.

One or both of the jaw members may be movable relative to the frame so as to move the jaw members from their first axial position to their second axial position.

The jaw members may be movable relative to each other in translation along said first and second axes so as to respectively cut, or crimp, wrapping material extending between adjacent articles.

The jaw members may also be movable relative to each other from their second axial position to their first axial position.

At least one of the jaw members may be provided with a cutting head for cutting through wrapping material extending between adjacent articles. Both of the jaw members may be provided with a said cutting head.

The first and second jaw members may be arranged such that when they are in their second axial position, their cutting heads may or may not contact each other.

The cutting heads of the first and/or second jaw members may be provided with a heating element for cutting wrapping material by melting through it. In this case, the cutting heads may not contact each other when the jaw members are in their second axial position. Where the cutting heads of the first and second jaw members are both provided with said heating elements, preferably the cutting heads do not contact each other when the jaw members are in their second axial position.

Where the cutting head of the first jaw member is provided with said heating element, the cutting head of the second jaw member may be made of a heat resistant material, for example rubber or any other suitable heat resistant material. In this case, the first and second jaw members may be arranged such that they contact each other when they are in their second axial position.

The cutting head may be provided with a cutting surface, for cutting through wrapping material. The cutting surface may be a serrated surface.

The cutting head may be arranged such that as the first and second jaw members move from their first axial position to their second axial position, the cutting surfaces shear past each other.

At least one of the jaw members may be provided with a crimping head for crimping wrapping material extending between adjacent articles. Both of the jaw members may be provided with a said crimping head. Each crimping head may be provided with a crimping surface.

When the first and second jaw members are in their second axial position, their crimping heads may contact each other.

The crimping heads of the first and/or second jaw members may be provided with a heating element for crimping wrapping material by fusing it together.

The first and/or second jaw members may be provided with both a crimping head and a cutting head. In this case, the apparatus may be a cutting and crimping apparatus.

The jaw members may be arranged to cut or crimp wrapping material along a cutting or crimping plane respectively as they move from their first axial position to their second axial position.

When the jaw members are in their first and/or second rotational positions they may be arranged to move from their first axial position to their second axial position in a cutting or crimping plane. The plane may be substantially vertical.

When the jaw members are in their second axial position they may meet along a line that forms a cutting, or crimping, line respectively.

When the jaw members are in their second axial position they may be spaced apart, with a cutting, or crimping, line respectively formed along a line that extends substantially midway between opposed cutting or crimping surfaces of the heads of the jaw members.

The respective cutting, or crimping, line of the jaw members when the jaw members are in their first rotational position may be inclined relative to the cutting, or crimping, line when the jaw members are in their second rotational position.

When the jaw members are in their first rotational position the cutting, or crimping, line may be substantially horizontal and when the jaw members are in their second rotational position the cutting, or crimping, line may be substantially vertical, or vice-versa.

The frame may form a first frame, with the jaw members attached to a second frame that is rotatable relative to the first frame such that the jaw members are rotatable from their first rotational position to their second rotational position relative to the first frame.

Preferably one of the first and second frames is provided with at least one carrier member and the other of the first and second frames is provided with at least one guide member, wherein the second frame is rotatably mounted to the first frame by engagement of the at least one carrier member and guide member, with the at least one carrier member being movable along the at least one guide member so as to allow rotation of the second frame relative to the first frame from the first rotational position to the second rotational position.

Preferably the engagement of the carrier member and guide member substantially prevents translational movement of the second frame relative to the first frame, while allowing said rotation of the second frame relative to the first frame.

The carrier member may comprise a protrusion and the guide member may comprise a guide channel, within which the protrusion is slidably movable. The guide channel may be a slot, groove, or the like.

There may be a plurality of sets of engageable said carrier members and guide members.

Preferably the second frame is substantially arcuate. Preferably the second frame is substantially ring shaped. The guide member is preferably elongate and extends along a longitudinal axis that is substantially arcuate. The plurality of sets of guide members and carrier members may be distributed in the radial direction of the second frame. The plurality of sets of guide members and carrier members may be distributed in the circumferential direction of the second frame. Radially adjacent guide members may overlap in the circumferential direction of the second frame.

The cutting, or crimping, apparatus may be provided with at least one retaining member that is operable to selectively rotationally fix the second frame relative to the first frame. The at least one retaining member may be mounted to one of the first or second frames and arranged to selectively engage the other of the first or second frames so as to rotationally fix the second frame relative to the first frame. The at least one retaining member may be a plunger. The cutting, or crimping apparatus, may comprise a plurality of said retaining members. The retaining members may be distributed circumferentially relative to the second frame.

Where the opposed jaw members are mounted on said second frame, preferably one or both of the jaw members is/are movable relative to the second frame, such that the jaw members are movable from their first axial position to their second axial position.

The at least one jaw member may be connected to an actuator arranged to move the jaw members relative to each other from its first axial position to its second relative position. Both the jaw members may be so connected to an actuator. The actuator may be any suitable actuator, including an electric or pneumatic actuator.

The jaw members may be mountable on the frame in a plurality of positions such that position of the respective cutting, or crimping, line relative to the frame is varied. Preferably when the jaw members are in said plurality of positions on the frame the position of the cutting, or crimping, line is varied within said cutting, or crimping plane. Preferably where the jaw members move between their first and second axial positions in a substantially vertical plane, the jaw members are mountable on the frame in a plurality of vertical positions such that the vertical position of the cutting, or crimping, line is varied. In this case the cutting, or crimping, heads are preferably arranged such that the cutting, or crimping, line is substantially horizontal.

In this respect, the first frame may be slidably mounted on a third frame such that the jaw members are mountable on the third frame in a plurality of positions. Preferably one of the first and third frames is provided with at least one carrier member and the other of the first and third frames is provided with at least one guide member, wherein the first frame is mounted to the third frame by engagement of the at least one carrier member and guide member, with the carrier member being movable along the guide member so as to allow the jaw members to be mounted on the third frame in said plurality of positions.

This is advantageous in that allows the position of the cutting, or crimping, line to be varied as desired. For example, where the cutting, or crimping, line is oriented horizontally, it allows the height of the cutting, or crimping, line to be varied in dependence on the height of the articles, such that the cutting, or crimping, line is always positioned substantially midway along the height of the articles. This maintains a uniform distribution of tension in the packaging.

According to a second aspect of the invention there is provided a cutting, or crimping, assembly comprising a cutting, or crimping, apparatus according to the first aspect of the invention, an inlet conveyor for transporting wrapped articles towards the cutting, or crimping, apparatus and an outlet conveyor for transporting wrapped articles away from the cutting, or crimping, apparatus.

The inlet conveyor and outlet conveyor may be spaced apart, with the cutting, or crimping apparatus being disposed in the gap between the inlet conveyor and outlet conveyor so as to cut, or crimp, wrapping material between adjacent articles as they pass from the inlet conveyor to the outlet conveyor.

The inlet and outlet conveyors may be arranged to transport individual articles, or collations of articles, through the cutting, or crimping, apparatus along a conveyor longitudinal axis.

The cutting, or crimping, apparatus may be arranged such that the first and second jaw members are movable, and at least a portion of the inlet and outlet conveyors are movable such that the gap between them is movable with the first and second jaw members, in the direction of said conveyor longitudinal axis, as the first and second jaw members are moved relative to each other from the first axial position to the second axial position.

The inlet and outlet conveyors may each comprise a conveyor belt driven by a plurality of rollers, wherein a rear roller of the inlet conveyor and a front roller of the outlet conveyor, disposed on opposite sides of the gap, are movable in the direction of said conveyor longitudinal axis such that said gap is movable in the direction of said conveyor longitudinal axis.

The first and second jaw members and/or the rear roller of the inlet conveyor and the front roller of the outlet conveyor may be mounted on a carriage that is slidably mounted for movement in the direction of said conveyor longitudinal axis. The cutting, or crimping, assembly may comprise an actuator coupled to the carriage so as to drive the carriage in the direction of said conveyor longitudinal axis.

The at least one jaw member may be rotatably mounted to the frame such that it is rotatable from its first rotational position to its second rotational position about the conveyor longitudinal axis. In this case, the at least one jaw member may revolve about the longitudinal axis as it moves from its first rotational position to its second rotational position.

Preferably the jaw members and frame are arranged such that the jaw members are movable between their first and second axial positions in a plane that is substantially perpendicular to said longitudinal axis.

According to a third aspect of the invention there is provided a packaging apparatus comprising: a wrapping material applicator for wrapping an article, or a collation of articles in a wrapping material, an applicator inlet conveyor for transporting unwrapped articles towards the applicator; an applicator outlet conveyor for transporting wrapped articles away from the applicator; wherein the packaging apparatus further comprises a cutting, or crimping, assembly according to the second aspect of the invention arranged to respectively cut, or crimp wrapping material extending between adjacent articles, or collations of articles.

The applicator outlet conveyor may be arranged to transport wrapped articles away from the wrapping material applicator to the cutting, or crimping, apparatus. In this case, the applicator outlet conveyor may form the inlet conveyor of the cutting, or crimping, assembly

The wrapping material applicator may be for helically wrapping articles.

The inlet and outlet applicator conveyors may be spaced apart, wherein the wrapping material applicator is disposed between said inlet and outlet applicator conveyors and which serves, in use, to pass the wrapping material between the spaced apart inlet and outlet applicator conveyors so as to wind it around and wrap one or more articles disposed in the space between the conveyors.

According to a fourth aspect of the invention there is provided a method of cutting, or crimping, wrapping material extending between adjacent articles, using a cutting, or crimping, apparatus according to the first aspect of the invention, comprising orienting the at least one jaw member in its first rotational position, moving the jaw members relative to each other from their first axial position to their second axial position so as to cut, or crimp wrapping material extending between adjacent articles, rotating the jaw members to their second rotational position and moving the jaw members relative to each other from their first axial position to their second axial position so as to cut, or crimp, wrapping material extending between adjacent articles.

Preferably the jaw members are moved relative to each other back from their second axial position to their first axial position.

The method may comprise moving the first and second jaw members, and at least a portion of the inlet and outlet conveyors are movable such that the gap between them is moved with the first and second jaw members, in the direction of the conveyor longitudinal axis, as the first and second jaw members are moved relative to each other from the first axial position to the second axial position.

According to a fifth aspect of the invention there is provided a method of packaging articles using a packaging apparatus according to the third aspect of the invention comprising: conveying unwrapped articles to the wrapping applicator; using the wrapping applicator to wrap an article

or a collation of articles with wrapping material; conveying the wrapped articles or collations of articles from the applicator to the cutting, or crimping, apparatus, using the cutting, or crimping, apparatus to cut, or crimp, wrapping material by orienting the at least one jaw member in its first rotational position, moving the jaw members relative to each other from their first axial position to their second axial position so as to cut, or crimp wrapping material extending between adjacent articles, rotating the at least one jaw member to its second rotational position and moving the jaw members relative to each other from their first axial position to their second axial position so as to cut, or crimp, wrapping material extending between adjacent articles.

Preferably the jaw members are moved relative to each other back from their second axial position to their first axial position.

Any of the features of any of the above aspects of the invention may be combined.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

FIG. **1** is a perspective view of a cutting assembly according to the present invention, wherein jaw members of the cutting assembly are in a first rotational position;

FIG. **2** is a front elevational view of the cutting assembly of FIG. **1**;

FIG. **3** is a front elevational view of a cutting apparatus of the cutting assembly shown in FIGS. **1** and **2** with a third frame of the cutting apparatus removed for illustrative purposes;

FIG. **4** is a side elevational view of the cutting apparatus shown in FIG. **3**;

FIG. **5** is a plan view of the cutting apparatus shown in FIG. **3**;

FIG. **6** is a perspective view of the cutting assembly shown in FIGS. **1** and **2**, wherein the jaw members are in a second rotational position;

FIG. **7** is a front elevational view of the cutting assembly of FIG. **6**;

FIG. **8** is a front elevational view of a cutting apparatus of the cutting assembly shown in FIGS. **6** and **7** with a third frame of the cutting apparatus removed for illustrative purposes;

FIG. **9** is a side elevational view of the cutting apparatus shown in FIG. **8**;

FIG. **10** is a plan view of the cutting apparatus shown in FIGS. **8** and **9**;

FIG. **11** is perspective view of a packaging apparatus comprising the cutting apparatus shown in the preceding figures;

FIG. **12** is a side elevational view of the packaging apparatus shown in FIG. **11**;

FIG. **13** is a front perspective view of a crimping apparatus that may be used in place of the cutting apparatus shown in the preceding figures, so as to form a crimping assembly, crimping apparatus and packaging apparatus comprising the crimping apparatus respectively;

FIG. **14** is a front elevational view of the crimping apparatus shown in FIG. **13**;

FIG. **15** is a side elevational view of the crimping apparatus shown in FIG. **13**, and

FIG. **16** is a plan view of the crimping apparatus shown in FIG. **13**.

FIG. **17** shows a perspective view of a packaging apparatus comprising a second embodiment of the crimping assembly;

FIG. **18** shows a front perspective view of the second embodiment of the crimping assembly of the packaging apparatus shown in FIG. **17**;

FIG. **19** shows a perspective view of a carriage of the crimping assembly shown in FIG. **18**;

FIG. **20** shows a view corresponding to that of FIG. **18**, but wherein the crimping apparatus and the inlet and outlet conveyors of the crimping assembly are in a first axial position;

FIG. **21** shows a view corresponding to that of FIG. **20**, but wherein the crimping apparatus and the inlet and outlet conveyors of the crimping assembly are in a second axial position; and

FIG. **22** shows an axial cross-sectional view of the crimping assembly shown in FIG. **18**.

Referring now to FIGS. **11** and **12** there is shown a packaging apparatus **1** in accordance with a third aspect of the present invention. The packaging apparatus **1** comprises an applicator inlet conveyor **2** arranged to transport unwrapped articles (A), in the form of substantially cylindrical cans, to a wrapping material applicator **3** and an applicator outlet conveyor **4** arranged to transport articles (A) wrapped by the applicator **3** from the applicator **3** to a cutting apparatus **5** according to a first aspect of the invention, of a cutting assembly **6** according to a second aspect of the invention.

The inlet and outlet applicator conveyors **2**, **4** are substantially straight (when viewed from above) and have a common longitudinal axis **69** (see FIG. **11**). They are of substantially the same width and are substantially vertically aligned with each other. The inlet and outlet applicator conveyors **2**, **4** are spaced apart, in the direction of the common longitudinal axis **69** and the applicator **3** is disposed between them.

The articles on the applicator inlet conveyor **2** are arranged into separate collations of articles spaced apart in the longitudinal direction **69**. The articles within each collation on the applicator inlet conveyor **2** are unsecured i.e. they are not secured together (e.g. by a tray) before they are wrapped by the applicator **3**.

The wrapping material applicator **3** incorporates a rotary applicator ring **9**. The applicator ring **9** rotates continuously about an axis that is substantially parallel to the common longitudinal axis **69** of the conveyors **2**, **4** and dispenses wrapping material **12** from reels **11** disposed at angular intervals around a front face of the applicator ring **9**. The reels **11** are attached to articles arriving on the outlet conveyor **4** by streams of wrapping material **12** which have just been wrapped around the articles. Thus, as the applicator ring **9** rotates, wrapping material **12** is pulled off the reels **11** and wrapped around articles following these articles, as they pass through the applicator ring **9**.

The wrapping material **12** on each reel **11** is in the form of a continuous elongate web of thin, stretchable synthetic plastics film such as a polyurethane based material. The film is stretchable in the lateral direction, as well as in the longitudinal direction. As the articles pass through the ring **9**, the wrapping material **12** is stretched and then wrapped in a helical fashion around the articles. The wrapping process continues as the articles progress along the inlet and outlet conveyors **2**, **4** such that the wrapping material **12** continues to be wound in a helical fashion around successive upstream articles so as to produce a continuous wrap of articles. The wrapping material **12** is designed to recover from the stretching so that it shrinks tightly around the articles after wrapping.

Since the articles on the applicator inlet conveyor **2** are arranged into separate collations of articles spaced apart in the longitudinal direction **69**, the wrapping material **12** is wrapped in a substantially continuous helical band around the gaps between successive collations of articles in the longitudinal direction **69**.

Referring now to FIGS. **1** and **2** there is shown the cutting assembly **6** according to the second aspect of the present invention, wherein opposed first and second jaw members **23**, **24** (see below) of the cutting assembly **6** are in a first rotational position.

The cutting assembly **6** comprises an inlet conveyor **4**, formed by the applicator outlet conveyor, arranged to transport the wrapped articles (A) from the applicator **3** to a cutting apparatus **5** (of the cutting assembly **6**) and an outlet conveyor **7** arranged to transport the articles, or collations of articles whose packaging has been cut by the cutting apparatus **5** to a discharge conveyor (not shown).

The inlet and outlet conveyors **4**, **7** are substantially straight (when viewed from above) and have a common longitudinal axis **8**. They are of substantially the same width and are substantially vertically aligned with each other. The inlet and outlet conveyors **4**, **7** are spaced apart, in the direction of the common longitudinal axis **8** and the cutting apparatus **5** is disposed between them.

The cutting apparatus **5** comprises a first frame **13**, a second frame **14** that is rotatably mounted to the first frame **13** and a pair of first and second jaw assemblies **15**, **16** that are mounted to the second frame **14**. The first frame **13** is mounted to a third frame **17** (as discussed in more detail below).

The third frame **17** comprises first and second elongate frame members **21**, **22** (see FIG. **2**) that are spaced apart in a lateral direction and extend along their length in a height direction. The first and second frame members **21**, **22** are oriented such that their lengths extend substantially vertically.

The first frame **13** comprises a substantially planar and substantially square plate **18** provided with a central bore **19** that extends from a front face to a rear face of the plate **18**. The plate **18** is oriented such that the plane of the plate is substantially perpendicular to the longitudinal direction **8**. The bore **19** is defined by a radially inner surface of the plate **18** and has a radius that is substantially equal to half the width (or height) of the plate **18** minus the width of the second frame **14** in the radial direction. The bore **19** has a longitudinal axis that is substantially perpendicular to the plane of the plate **18**. The longitudinal axis of the bore **19** is substantially parallel to the common longitudinal axis **8** of the inlet and outlet conveyors **4**, **7**.

Sides of the plate **18** that are opposed in the width direction of the plate **18** are mounted to the first and second frame members **21**, **22** of the third frame **17** (as described in more detail below).

The second frame **14** is generally ring shaped and has a central longitudinal axis that is concentric with, and parallel to, the longitudinal axis of the bore **19** in the plate **18**. The second frame **14** has a radially inner surface that has substantially the same diameter as the central bore **19** in the plate **18** and has a radially outer surface that has a diameter that is substantially equal to the width (or height) of the plate **18** of the first frame **13**.

The first and second jaw assemblies **15**, **16** are attached to the second frame **14** at opposed radial positions on the frame **14**. Each jaw assembly **15**, **16** comprises a jaw member **23**, **24** connected to a pair of actuator rods **25** housed within a respective pair of pneumatic cylinders formed within a cylinder housing **26** (see FIG. **2**). Each cylinder housing **26** is fixedly attached to the second frame **14**. Each jaw member **23**, **24** is provided with a cutting head **47** that is generally elongate and has a generally 'V-shaped' cross-sectional shape about its longitudinal axis. The apex of the 'V-shaped' cross-sectional shape forms a cutting surface **31**. The cutting surfaces **31** of the cutting heads **47** are opposed to each other. Each cutting head **47** is provided with a heating element (not shown), which runs along the length of the cutting head **47**.

The cutting surfaces **31** are substantially perpendicular to the axial direction **101** of movement of the jaw members **23**, **24** (see below). The opposed cutting surfaces **31** of each jaw member **23**, **24** are substantially parallel to each other. The opposed cutting surfaces **31** are substantially straight and are substantially aligned in the longitudinal direction **8**, as well as in the lateral direction (which is a direction perpendicular to the longitudinal direction **8** and the height direction).

Each cutting surface **31** is elongate, extending in the lateral direction (when the jaw members **23**, **24** are in their first rotational position).

Alternatively the cutting surfaces **31** may be serrated.

The actuator rods **25** are pneumatically driven within the pneumatic cylinders, by air supplied from a pneumatic pump (not shown), to form a pneumatic actuator, so as to move each jaw member **23**, **24** towards the other, in an axial direction **101** (see FIG. **2**). The axial direction **101** is in the radial direction of the second frame **14**. When the first and second jaw members **23**, **24** are in the first rotational position (see FIG. **2**), the axial direction **101** is substantially vertical.

The pneumatic actuator is arranged to drivably move each jaw member **23**, **24** in the axial direction **101** from a first axial position (shown in FIGS. **1** to **5** and **6** to **10**) to a second axial position (not shown). In the first axial position the jaw members **23**, **24**, and their cutting surfaces **31**, are spaced apart in the axial direction **101** so as to allow articles to pass between the jaw members **23**, **24** from the inlet conveyor **4** to the outlet conveyor **7**.

As the jaw members **23**, **24** pass from the first axial position to the second axial position their cutting surfaces **31** cut through the wrapping material by melting of the wrapping material by the heating elements.

When the jaw members **23**, **24** are in the second axial position their cutting heads **47** are spaced slightly apart in the axial direction **101**. The cutting heads **47** define a cutting line **30** (see FIG. **1**) which extends substantially midway between the cutting heads in the axial direction **101**. This line **30** will be referred to as a cutting line **30**.

Specifically, the cutting line **30** is a line which extends substantially midway between the cutting surfaces **31** in the axial direction **101**.

The pneumatic actuator is also arranged to move the jaw members **23**, **24** away from each other, in the axial direction **101** back from their second axial position to their first axial position (e.g. by suitable exhausting of air from the pneumatic cylinders). This allows subsequent articles to pass between the jaw members **23**, **24**.

The jaw members **23**, **24** are movable between their first and second axial positions in a plane that is substantially perpendicular to the longitudinal direction **8**, when the first and second jaw members **23**, **24** are in both their first and second rotational positions (see below). The jaw members **23**, **24** act to cut the wrapping material within this plane. In the orientation of the cutting apparatus **5** shown in the figures this plane is substantially vertical.

Since the cutting surfaces **31** of each cutting head **47** are substantially straight and substantially parallel, the cutting line **30** is substantially straight. The cutting surfaces **31** of

the jaw members **23**, **24** are arranged such that the cutting line **30** is substantially perpendicular to the longitudinal direction **8** when the first and second jaw members **23**, **24** are in both the first and second rotational positions (see below).

The second frame **14** is rotatably mounted to the first frame **13** such that it is rotatable relative to the first frame **13** from a first rotational position as shown in FIGS. **1** to **5**, to a second rotational position as shown in FIGS. **6** to **10**, and vice versa. Since the first and second jaw assemblies are fixed to the second frame **14**, they rotate with the second frame between respective first and second rotational positions relative to the first frame **13**.

The second frame **14** (and so the first and second jaw members **23**, **24**) rotates from the first rotational position to the second rotational position about the central longitudinal axis of the second frame. In this respect, since this axis is external to the first and second jaw members, the first and second jaw members revolve about, i.e. orbit, the longitudinal axis as they move from their first rotational position to their second rotational position. As first and second jaw members **23**, **24** move they do not rotate about an internal axis (an axis internal to the jaw members **23**, **24**), i.e. they do not spin.

In the first rotational position (as shown in FIGS. **1** to **5**), the axial direction **101** in which the jaw members move from their first position to their second position, is substantially vertical. The jaw members **23**, **24** are substantially horizontal and form a cutting line **30** that is substantially horizontal.

In the second rotational position (as shown in FIGS. **6** to **10**), the axial direction **101** in which the jaw members move from their first position to their second position, is substantially horizontal (see FIG. **7**). The jaw members **23**, **24** are substantially vertical and form a cutting line **30** that is substantially vertical.

The second frame **14** is rotatably mounted to the first frame **13** by the engagement of a plurality of carrier and guide members, as will now be described.

The second frame **14** is provided with a plurality of guide members in the form of elongate slots **32** that extend in the circumferential direction of the second frame **14**, part way along the circumference of the second frame **14**, from a first end to a second end. Each slot **32** extends throughout the thickness of the second frame **14** from its front face to its rear face. Pairs of slots **32** on each side of the second frame **14** are spaced in the radial direction and partially overlap in the circumferential direction.

The first frame **13** is provided with a plurality of carrier members in the form of protrusions **33**. Each protrusion **33** is generally mushroom shaped comprising a generally cylindrical shaft that extends from an inner end attached to the front face of the plate **18** of the first frame **13**, in a direction substantially perpendicular to the plane of the plate **18** to an outer end of greater radius than the shaft to form a head.

Each protrusion **33** is slidably received within a corresponding slot **32**. The shaft of each protrusion **33** extends through the slot **32**, from the rear face to the front face of the second frame **14** with an inner surface of the head of the protrusion **33** abutting the front face of the second frame **14**. The head of each protrusion **33** is wider than the slot that it is received in. Accordingly, the protrusions **33** substantially fix the second frame **14** in the longitudinal direction **8** relative to the first frame **13**.

In the first rotational position each protrusion **33** is disposed at the first circumferential end of the respective slot **32**. As the second plate **14** is rotated relative to the first plate **13**, from the first rotational position to the second rotational position, each slot **32** is rotated relative to the first plate **13** until the second end of the slot reaches the respective protrusion **33**. In this way, each protrusion **33** acts as a stop member as the second frame **14** rotates from its first rotational position to its second rotational position and back again. From the view shown in FIGS. **2** and **7**, the second plate **14** is rotated relative to the first plate **13** in an anti-clockwise direction from the first rotational position to the second rotational position.

The second frame **14** is manually rotatable relative to the plate **18** between its first and second rotational positions. Alternatively, or additionally, the cutting apparatus **5** may be provided with an actuator (e.g. a pneumatic or electric actuator) that is mechanically connected to the second frame **14** so as to rotate the second frame **14** relative to the first frame **13**.

The second frame **14** is provided with a plurality of collars **43** (see FIG. **3**) distributed circumferentially around the radially outer periphery of the second frame **14**. Each collar **43** is integrally formed with the second frame **14** and projects radially outwardly from the radially outer surface of the second frame **14**. Each collar is provided with a circular bore which receives a retaining plunger **40**. Each retaining plunger **40** is free to rotate within its collar **43**.

Each retaining plunger **40** comprises a threaded shaft that extends from a first end proximal the front surface of the respective collar **43** to a second end, distal to the front surface of the respective collar **43**. The first end is provided with a head of greater diameter than the shaft and of greater diameter than the aperture in the collar **43**, such that the retaining plunger **40** is axially retained within the collar **43**.

The plate **18** is provided with a plurality of bores **41** distributed circumferentially around the radially outer periphery of the second frame **14** (see FIG. **3**). Each bore has a complementary thread to that of the shaft of the plunger **40**. The plungers **40** and bores **41** are arranged such that when the second frame **14** is in its first and second rotational positions, each plunger **40** is aligned with a respective bore **41**.

The threaded shaft of each plunger **40** is screwedly engageable within each bore **41** so as to move the head of the plunger **40** between a first position and a second position. In the first position the head of the plunger **40** is positioned such that it does not clamp the second frame **14** against the front face of the plate **18**. This allows the second frame **14** to rotate relative to the plate **18**.

When the retaining plunger **40** is move to its second position, the inner face of the head of the plunger **40** is moved towards the front face of the plate **18**. When the plunger **40** reaches its second position, the second frame **14** is clamped between said inner face of the head of the plunger **40** and the front face of the plate **18**. This acts to rotationally fix the second frame **14** relative to the plate **18**.

Accordingly the retaining plungers **40** and bores **41** are arranged to selectively prevent and allow rotation of the second frame **14** relative to the first frame **13** in the first and second rotational positions. It will be appreciated that additional plungers **40** and bores **41** may be used such that the second frame **14** may be rotationally fixed relative to the first frame in additional rotational positions, e.g. rotational positions between the first and second rotational positions.

The jaw assemblies **15**, **16** and the first, second and third frames **13**, **14**, **17** are arranged such that the jaw members **23**, **24** may be mounted on the third frame **17** in a plurality of vertical positions on the frame **17** so as to vary the vertical position of the cutting line **30**, i.e. so as to vary the position of the cutting line **30** within the plane in which the jaw members **23**, **24** are movable between their first and second

axial positions. In this respect, the sides of the plate **18** that are opposed in the width direction of the plate **18** are each provided with a pair of roller carriages **60**, disposed at upper and lower ends of the sides. Each roller carriage **60** comprises a housing **62** that is fixedly attached to the plate **18** and a pair of rollers **61** that are rotationally mounted to the housing **62**. Each of the first and second frame members **21**, **22** of the third frame **17** is provided with an elongate guide channel **65**, for receiving the rollers of a respective pair of carriages **60**. The carriages **60** and the guide channels **65** are arranged such that the plate **18** is vertically slidable along the length of the first and second frame members **21**, **22**.

This is advantageous in that it allows the height of the cutting line **30** to be varied within said plane. This allows the height of the cutting line **30** to be varied, in dependence on the height of the articles, such that the cutting line **30** is always positioned substantially midway along the height of the articles. This maintains a uniform distribution of tension in the packaging.

In operation, the articles wrapped by the applicator **3** are passed from the applicator **3** to the cutting apparatus **5** by the inlet conveyor **4**. As stated above, the wrapping material extends around the longitudinal gaps between spaced collations of articles. The jaw members **23**, **24** are initially in their first rotational position and are in their first axial position (as shown in FIG. **2**). As the gap between adjacent articles passes the jaw members **23**, **24**, the pneumatic actuator is operated so as to move both jaw members **23**, **24** towards each other, so as to move the jaw members **23**, **24** from their first axial position to their second axial position (in the direction of axis **101**). As the jaw members reach their second axial position, the cutting surfaces **31** of the jaw members **23**, **24** cut wrapping material extending between the adjacent collations, as described above. The pneumatic actuator is then operated to move the jaw members **23**, **24** back to their first axial position, which allows for the next upstream collations to pass between the jaw members **23**, **24**. The process is then repeated so as to cut wrapping material extending between the next pair of adjacent collations.

The second frame **14**, and the first and second jaw members **23**, **24**, are initially oriented in their first rotational positions (as shown in FIGS. **1** to **5**).

In the first rotational position (as shown in FIGS. **1** to **5**), the axial direction **101** in which the jaw members move from their first position to their second position, is substantially vertical. The jaw members **23**, **24** are substantially horizontal and form a cutting line **30** that is substantially horizontal. In this position, the protrusions **33** are each received at the first ends of the respective slots **32**.

If it is desired to change the orientation of the axial direction **101**, for example due to a change in dimension of the articles, then the cutting jaw members **23**, **24** are moved from the first rotational position to the second rotational position, as will now be described. Firstly, the retaining plungers **40** are unscrewed from their second position to their first position, so as to permit rotational movement of the second frame **14** relative to the plate **13**. The second frame **14** is then rotated, either manually or by an appropriate actuator, from the first rotational position to the second rotational position. As it does so, the slots **32** are rotated until the second end of the slot **32** reaches the respective protrusion **33**.

In the second rotational position (as shown in FIGS. **6** to **10**), the axial direction **101** in which the jaw members move from their first position to their second position, is substantially horizontal (see FIG. **7**). The jaw members **23**, **24** are substantially vertical and form a cutting line **30** that is substantially vertical.

The jaw members **23**, **24** may be moved back from the second rotational position to the first rotational position, as desired, by following the reverse procedure.

Referring now to FIGS. **13** to **16** there is shown a crimping apparatus **200** according to the first aspect of the invention. The crimping apparatus **200** is substantially the same, and works in substantially the same way, as the cutting apparatus **5** shown in FIGS. **1** to **12**, except in that the cutting heads **47** of the jaw members **23**, **24** are replaced with crimping heads **201** which act to crimp the wrapping material (as well as cutting it). The same reference numerals are used in FIGS. **13** to **16**, as in the preceding figures, so as to show the corresponding features.

Each crimping head **201** is generally elongate and is provided with a generally flat crimping surface **202**. The crimping surfaces **202** of each crimping head **201** are opposed to each other. The crimping surfaces **202** are substantially perpendicular to the axial direction **101** of movement of the jaw members **23**, **24**.

The opposed crimping surfaces **202** of each jaw member **23**, **24** are substantially parallel to each other. The opposed crimping surfaces **202** are substantially straight and are substantially aligned in the longitudinal direction **8**, as well as in the lateral direction (which is a direction perpendicular to the longitudinal direction **8** and the height direction). Each crimping head **201** is provided with a heating element (not shown), which runs along the length of the crimping head **201**.

As with the cutting apparatus **5**, the pneumatic actuator is arranged to drivably move the jaw members **23**, **24** towards each other in the axial direction **101** from a first axial position (shown in FIGS. **13** and **14**) to a second axial position. In the first axial position the jaw members **23**, **24** are spaced apart in the axial direction **101** so as to allow articles to pass between the jaw members **23**, **24** from the inlet conveyor **4** to the outlet conveyor.

As the jaw members move from their first axial position to their second axial position, their crimping surfaces **202** compress together the upper and lower sections of wrapping material extending between adjacent articles. In the second axial position the crimping surfaces of the crimping heads abut each other along a line **50** (see FIG. **14**), which will be referred to as a crimping line **50**. The heating elements on the crimping surfaces **202** act to fuse the wrapping material together as the crimping surfaces compress the wrapping material together. This acts to both crimp and cut the wrapping material extending between adjacent articles.

It will be appreciated that the crimping apparatus **200** otherwise functions in the same way as the cutting apparatus **5**. For example, the jaw members **23**, **24** are rotatable between their first and second rotational positions (with the first rotational position shown in FIGS. **13** and **14**), in the same way as for the cutting apparatus **5**, so as to vary the axial direction **101** in which the jaw members **23**, **24** are moved between their first and second axial positions.

The jaw members **23**, **24** are movable between their first and second axial positions in a plane that is substantially perpendicular to the longitudinal direction **8**, when the first and second jaw members **23**, **24** are in both their first and second rotational positions (see below). The jaw members **23**, **24** act to crimp the wrapping material within this plane.

The crimping line **50** is directly analogous to the cutting line **30** of the cutting apparatus **5** and references to the crimping line **50** and how it may be rotated between a first

position and a second position, by rotation of the second frame **14** relative to the first frame **13**, are to be construed accordingly.

In addition, the jaw assemblies **15**, **16** and the first, second and third frames **13**, **14**, **17** are arranged such that the jaw members **23**, **24** may be mounted on the third frame **17** in a plurality of vertical positions on the frame **17** so as to vary the vertical position of the crimping line **50**.

It will be appreciated that the crimping apparatus **200** may be substituted for the cutting apparatus **5** in the assembly of FIGS. **1** and **2** (and FIGS. **6** and **7**), so as to form a crimping assembly. Similarly, it will be appreciated that the crimping apparatus **200** may be substituted for the cutting apparatus **5** in the packaging apparatus of FIGS. **11** and **12**.

The above described arrangement is advantageous in that the jaw members **23**, **24** of the cutting and crimping assemblies may be rotated between their first and second positions, so as to vary their axial direction of movement between their first and second axial positions, depending on the relative dimensions of the articles passing to the cutting, or crimping apparatus.

For example, if the articles carried on a conveyor to the cutting or crimping apparatus are relatively tall and narrow, it is preferable that the axial direction of movement of the jaw members **23**, **24** is substantially horizontal. Conversely, if the articles are relatively short and wide it is preferable that the axial direction of movement of the jaw members **23**, **24** is substantially vertical. Orienting the axial direction of movement of the jaw members **23**, **24** in this manner is advantageous in that it shortens the distance that the jaw members **23**, **24** need to travel in order to cut, or crimp, wrapping material extending between adjacent articles, thereby reducing the length of wrapping material that the jaw members need to cut or crimp through. In this respect, the length of wrapping material that each point on the jaw member has to cut or crimp through is reduced. This reduces the energy that is lost as heat during the cutting or crimping, thereby resulting in a more efficient cutting or crimping, apparatus.

In addition, this change of orientation may be done quickly and easily. In this respect, it is not necessary to remove a cutting, or crimping, apparatus that has a first (e.g. horizontal or vertical) orientation of said axial direction of movement of the jaw members **23**, **24** and to replace it with a separate cutting, or crimping, apparatus that has a second (e.g. vertical or horizontal) orientation of said axial direction. This therefore saves time and cost. In this respect, since the productivity of a production line apparatus is highly dependent on the number of articles that are wrapped per unit time, any stoppages in a production line result in a significant economic loss. In addition, costs are saved as it is not necessary to providing separate cutting or crimping apparatus with different jaw orientations and as it is not necessary to employ skilled personnel in order to change the cutting, or crimping, apparatus.

In addition, the height at which the jaw members meet each other, i.e. the height of the cutting, or crimping, line may be varied quickly and easily. This allows the height of cutting, or crimping, line to be varied, in dependence on the height of the articles, such that the cutting, or crimping, line is always positioned substantially midway along the height of the articles. This maintains a uniform distribution of tension in the packaging.

Referring to FIGS. **17** to **22** there is shown a packaging apparatus **501** according to a further embodiment of the invention. The packaging apparatus **501** is identical to the packaging apparatus **1** shown in FIG. **11** when comprising the crimping assembly shown in FIGS. **13** to **15**, except for the differences described below. Features of the packaging apparatus **501** that correspond to features of the packaging apparatus shown in FIGS. **11** and **12** and that correspond to features of the crimping assembly shown in FIGS. **13** to **16** are given corresponding reference numerals, but incremented by 500.

The crimping assembly **850** shown in FIG. **18** differs from that shown in FIGS. **13** to **16** in how the jaw members **523**, **524** (and therefore their crimping heads **701**) are moved from the first axial position to the second axial position. In this regard, each jaw member **523**, **524** is provided, at either end of the jaw member **523**, **524**, with a collar **810**, **811**. The collars **810**, **811** are coupled to an actuator in the form of a servomotor **803** by first and second linear belt drives **801**, **802**. A transmission is disposed between the linear belt drives **801**, **802** and the servomotor **803**.

Each collar **810**, **811** is slidably mounted on a respective linear guide member **806** (the second linear guide member is omitted from FIG. **18** for illustrative purposes).

Rotation of the servomotor **803** drives the linear belt drives **801**, **802** which moves the jaw members **523**, **524** (and therefore the crimping heads **701**) towards and away from each other between the first and second axial positions.

Alternatively, the means of moving the jaw member **523**, **524** between their first and second axial positions may be that of any of the preceding embodiments.

In this embodiment, the first and second jaw members **523**, **524**, the linear drive belts **801**, **802** and the servomotor **803** are each mounted on the second frame **514**. The second frame **514** is rotatably mounted on the first frame **513** as with the preceding embodiment.

In this embodiment, the crimping apparatus **700** and the gap between the inlet and outlet conveyors **4**, **7** are arranged to move in the conveyor axial direction **508** so as to move axially with the articles on the conveyor as the packaging between the articles is crimped by the crimping heads **701**, i.e. as the jaw members **523**, **524** move between the first and second axial positions.

In more detail, the crimping assembly **850** further comprises a carriage **813**. The carriage **813** comprises substantially horizontal upper and lower plates **814**, **815** (see FIG. **19**) attached to each other by a pair of substantially vertical struts **816** that are disposed at laterally opposite sides of a front end of the plates **814**, **815** and extend between opposed surfaces of the plates **814**, **815**.

The crimping apparatus **700** is mounted on the carriage **813** between the upper and lower plates **814**, **815**. In this regard, the crimping apparatus **700** is fixably attached to the carriage **813** such that it moves axially with the carriage **813** (as described below).

Each of the inlet and outlet conveyors **504**, **507** comprises a respective conveyor belt **901**, **902** that passes around a plurality of conveyor rollers **831**, **832** (see FIG. **22**). The rotation of the conveyor rollers **831**, **832** drives the conveyor belts **901**, **902**. The rear roller **831'** of the inlet conveyor **504** and the front roller **832'** of the outlet conveyor **507** are disposed on opposite axial sides of the gap **840** between the conveyors **504**, **507**, in which the crimping apparatus **700** is located.

The carriage **813** is provided with first and second pairs of roller attachment assemblies **905**, **906**. Each conveyor roller attachment assembly **905**, **906** comprises a pair of laterally spaced substantially vertical roller attachment members **819**, **820**.

The roller attachment members **819** of the first roller attachment assembly **905** are attached to laterally opposite ends of the front roller **832'** of the outlet conveyor **507**.

Similarly, the first and second roller attachment members **820** of the second roller attachment assembly **906** are attached to laterally opposite ends of the rear roller **831'** of the inlet conveyor **504**.

The roller attachment assemblies **905**, **906** are fixably attached to the lower plate **814** of the carriage **813**, so as to move axially with the carriage **813**.

The carriage **813** is slidably mounted, for movement in the axial direction **508** (in both the forward and backwards directions), on upper and lower pairs of guide rails **860**, **861**. The carriage **813** is moved in the axial direction by a linear drive belt that is driven by a servomotor (not shown).

As the carriage **813** moves in the axial direction **508**, the cutting apparatus **700** moves in the axial direction **508** by virtue of its mounting on the carriage. Similarly, the conveyor rollers **831'**, **832'** are moved by the respective conveyor roller assemblies **905**, **906** in the axial direction **508**, with the crimping apparatus **700**. In this way, the gap **840** between the inlet and outlet conveyors **504**, **507** moves in the axial direction **508** with the jaw members **523**, **524** (and therefore the crimping heads **701**).

In this regard, FIGS. **20** and **21** show where the crimping apparatus **700** and the inlet and outlet conveyors **504**, **507** are in first and second axial positions (along the axis **508**) respectively. The second axial position is forward of the first axial position, in the direction of movement of articles on the conveyors **504**, **507**.

This allows the jaw members **523**, **524** and the gap **840** to move axially with the articles on the conveyors **504**, **507** as the packaging between the articles is crimped by the crimping heads **701**, i.e. as the jaw members **523**, **524** are moved between the first and second axial positions, with the jaw members **523**, **524** passing through the gap **840** between the inlet and outlet conveyors **504**, **507** as they do so.

This is advantageous in that it enables the packaging between articles to be crimped without having to start and stop the inlet and outlet conveyors **504**, **507**. In addition, it allows the speed of movement of the jaw members **523**, **524**, as they move from their first to their second axial position, to be decreased.

Furthermore, the use of the servomotor **803** and the linear belt drives **801**, **802** allows for greater flexibility in setting the gap between the jaw members **523**, **524** in the second axial position. The servomotor **803** can also control the movement of the jaw members **523**, **524** from their first axial position to their second axial position, and vice-versa, with a high degree of precision. It is also possible to programme various setups for multi pack size machines.

In the described embodiment both the first and second jaw members **523**, **524** move axially as the jaw members **523**, **524** move from their first axial position to their second axial position. Alternatively, one of the jaw members may be fixed (in the direction of said movement from the first axial position to the second axial position) with the other jaw member being moved from the first axial position to the second axial position. Preferably, the second jaw member **524** is fixed in this way, with the first jaw member **523** being movable from the first axial position to the second axial position.

As with the preceding embodiments, the second frame **514** is vertically slidably mounted on a third frame **517** so as to vary the vertical position of the crimping line.

It will be appreciated that the cutting or crimping apparatus of the preceding embodiments may be used in place of the crimping apparatus **700** of this embodiment.

It will be appreciated that numerous modifications to the above described design may be made without departing from the scope of the invention as defined in the appended claims.

For example, in the described embodiments both the first and second jaw members **23**, **24** are movable in the axial direction **101**, by the pneumatic actuator, so as to move the jaw members **23**, **24** between said first and second relative axial positions. Alternatively, only one of the jaw members **23**, **24** may be movable between a first and second axial position, with the other jaw member being stationary.

In the described embodiment both the first and second jaw members **23**, **24** are rotatable from the first rotation position to the second rotational position. Alternatively, only one of the jaw members **23**, **24** may be rotatable between the first and second rotational positions, with the other jaw member being stationary. In this respect, each jaw member **23**, **24** may have curved cutting/crimping surfaces that circumferentially overlap when the jaw members **23**, **24** are in both their first and second rotational positions. The jaw members **23**, **24** may translate relative to the frame as they rotate from their first rotational position to their second rotational position. However, it is preferable that they do not translate as they rotate from their first rotational position to their second rotational position.

In the described embodiments when the jaw members **23**, **24** are in their first rotational position, the axial direction **101** in which the jaw members move from their first axial position to their second axial position, is substantially vertical. When the jaw members **23**, **24** are in the second rotational position, the axial direction **101** in which the jaw members move from their first axial position to their second axial position, is substantially horizontal. However, it will be appreciated that when the jaw members **23**, **24** are in the first and second rotational positions, the respective axial directions **101** may have different orientations, i.e. orientations that are not substantially horizontal or vertical.

Similarly, in the described embodiment when the second frame **14** is in the first rotational position, the cutting/crimping surfaces **31**, **202** of the jaw members **23**, **24** are oriented such that the cutting/crimping line **30**, **50** is substantially horizontal and in the second rotational position, the cutting/crimping surfaces **31**, **202** of the jaw members **23**, **24** are oriented such that the cutting/crimping line **30**, **50** is substantially vertical. However, it will be appreciated that when the second frame **14** is in the first and second rotational positions the cutting/crimping surfaces **31**, **202** of members **23**, **24** may be oriented such that the cutting/crimping line **30**, **50** has different orientations, i.e. orientations that are not substantially horizontal or vertical.

In the described embodiment the crimping/cutting surfaces **31**, **202** of the jaw members **23**, **24** are substantially straight, which produces a cutting/crimping line **30**, **50** that is substantially straight. However, it will be appreciated that the cutting/crimping surfaces **31**, **202** may not be substantially straight, for example they may be curved, or serrated in the longitudinal direction of the surface to produce a cutting/crimping line **30**, **50** that has a corresponding shape, e.g. curved or serrated in the longitudinal direction. Similarly, in the described embodiment the cutting/crimping surfaces **31**, **202** are substantially perpendicular to the longitudinal direction **8**. Alternatively, the cutting/crimping surfaces **31**, **202** may be oriented such that the cutting/

crimping line **30**, **50** is inclined relative to the direction that is substantially perpendicular to the longitudinal axis **8**.

In the described embodiment the crimping apparatus both cuts and crimps the wrapping material. Alternatively it may be arranged to only crimp the wrapping material.

In the described embodiment the cutting heads do not meet when the jaw members **23**, **24** are in the second axial position. Alternatively, they may meet, i.e. abut, when the jaw members **23**, **24** are in the second axial position. In this case, the first cutting head may comprise a heating element and the second cutting head may be formed of a suitable heat resistant material, e.g. rubber. It will also be appreciated that the cutting and crimping heads may take any suitable shape.

In the described embodiment the crimping and cutting surfaces of the crimping and cutting heads are substantially perpendicular to the axial direction **101** of the jaw members **23**, **24**. Alternatively, the crimping and cutting surfaces may be inclined relative to a direction substantially perpendicular to the axial direction **101** of the jaw members **23**, **24**.

In the described embodiment the packaging apparatus is shown in its typical orientation in use, where the inlet and outlet conveyors **4**, **7** of the cutting/crimping assemblies are substantially horizontal and the first and second frame members **21**, **22** of the third frame **17** are oriented such that their lengths extend substantially vertically. However, it will be appreciated that the inlet and outlet conveyors **4**, **7** and the first and second frame members **21**, **22** of the third frame **17** may be oriented differently, as desired.

In the described embodiment the actuator is a pneumatic actuator. However, it will be appreciated that any suitable actuator may be used, including an electric actuator, an electro-magnetic actuator, etc.

In the described embodiments of the invention, the inlet and outlet conveyors **2**, **4** are substantially straight. However, it will be appreciated that the inlet and/or outlet conveyors **2**, **4** may be curved (when viewed from above). In this case, the respective longitudinal axes of the inlet and/or outlet conveyors **2**, **4** will be curved. It is not necessary that the inlet and outlet conveyors **2**, **4** have a common longitudinal axis. In addition, the inlet and outlet conveyors **2**, **4** may not be substantially vertically aligned (although this is preferable) and may be of different widths.

In the described embodiment the retaining plungers are mounted to the second frame **14**. Alternatively, the retaining plungers **40** may be mounted to the first frame **13** and be selectively moveable to engage the second frame **14** so as to clamp the second frame **14** between said inner face of the head of the plunger **40** and the front face of the plate **18**. This acts to selectively rotationally fix the second frame **14** relative to the plate **18**. In the described embodiment, the roller carriages **60** are mounted on the plate **18** and the guide channels **65** are mounted on the third frame **17**. Alternatively, the roller carriages **60** may be mounted on the third frame **17**, with the guide channels **65** mounted on the plate **18**. Furthermore, it will be appreciated that any suitable guide arrangement may be used that allows the jaw members to be mounted on the third frame **17** in a plurality of vertical positions on the frame **17** so as to vary the vertical position of the cutting or crimping line.

In the described embodiment the articles are substantially cylindrical cans. However, it will be appreciated that the articles may take different shapes and sizes and could be any type of article to be wrapped.

The described and illustrated embodiments are to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments have been shown and described and that all changes and modifications that come within the scope of the inventions as defined in the claims are desired to be protected. It should be understood that while the use of words such as "preferable", "preferably", "preferred" or "more preferred" in the description suggest that a feature so described may be desirable, it may nevertheless not be necessary and embodiments lacking such a feature may be contemplated as within the scope of the invention as defined in the appended claims. In relation to the claims, it is intended that when words such as "a," "an," "at least one," or "at least one portion" are used to preface a feature there is no intention to limit the claim to only one such feature unless specifically stated to the contrary in the claim. When the language "at least a portion" and/or "a portion" is used the item can include a portion and/or the entire item unless specifically stated to the contrary.

The invention claimed is:

1. A cutting, or crimping, assembly comprising:

a cutting, or crimping, apparatus;

an inlet conveyor for transporting wrapped articles towards the cutting, or crimping, apparatus; and

an outlet conveyor for transporting wrapped articles away from the cutting, or crimping, apparatus

wherein the cutting, or crimping, apparatus comprises first and second opposed jaw members which are mounted on a frame and are movable relative to each other from a first axial position to a second axial position along an axis so as to respectively cut, or crimp, wrapping material extending between adjacent articles wherein at least one of the jaw members is rotatably mounted to the frame such that it is rotatable from a first rotational position to a second rotational position, in the first rotational position the jaw members are movable relative to each other along a first said axis and in the second rotational position the jaw members are movable relative to each other along a second said axis that is inclined relative to the first axis; and

wherein the inlet and outlet conveyors are arranged to transport individual articles, or collations of articles, through the cutting, or crimping, apparatus along a longitudinal axis and the at least one jaw member is rotatably mounted to the frame such that it is rotatable from its first rotational position to its second rotational position about the longitudinal axis, wherein the frame forms a first frame, with the jaw members attached to a second frame that is substantially ring-shaped and rotatable relative to the first frame such that the jaw members are rotatable from their first rotational position to their second rotational position relative to the first frame.

2. A cutting, or crimping, assembly according to claim **1** wherein the at least one jaw member rotates from its first rotational position to its second rotational position about an external rotational axis.

3. A cutting, or crimping, assembly according to claim **1** wherein the at least one jaw member is both of the jaw members.

4. A cutting, or crimping, assembly according claim **1** wherein at least one of the jaw members is provided with a cutting or crimping head for cutting through or crimping wrapping material extending between adjacent articles.

5. A cutting, or crimping, assembly according to claim **4** wherein the first and second jaw members are both provided with a cutting or crimping head, and wherein the first and second jaw members are arranged such that when they are in their second axial position, their cutting, or crimping, heads do not contact each other.

6. A cutting, or crimping, assembly according to claim 4 wherein the first and second jaw members are both provided with a cutting or crimping head, and wherein the first and second jaw members are arranged such that when they are in their second axial position, their cutting, or crimping, heads contact each other.

7. A cutting, or crimping, assembly according to claim 1 wherein the jaw members are arranged to cut or crimp wrapping material along a cutting or crimping plane respectively, as they move from their first axial position to their second axial position.

8. A cutting, or crimping, assembly according to claim 1 wherein one of the first and second frames is provided with at least one carrier member and the other of the first and second frames is provided with at least one guide member, wherein the second frame is rotatably mounted to the first frame by engagement of the at least one carrier member and guide member, with the at least one carrier member being movable along the at least one guide member so as to allow rotation of the second frame relative to the first frame from the first rotational position to the second rotational position.

9. A cutting, or crimping, assembly according to claim 8 wherein the engagement of the carrier member and guide member substantially prevents translational movement of the second frame relative to the first frame, while allowing said rotation of the second frame relative to the first frame.

10. A cutting, or crimping, assembly according to claim 1 wherein the second frame is substantially arcuate.

11. A cutting, or crimping, assembly according to claim 8 wherein the guide member is elongate and extends along a longitudinal axis that is substantially arcuate.

12. A cutting, or crimping, assembly according to claim 1 herein the cutting, or crimping, apparatus is provided with at least one retaining member that is operable to selectively rotationally fix the second frame relative to the first frame.

13. A cutting, or crimping, assembly according to claim 1 wherein the jaw members are mountable on the frame in a plurality of positions such that position of the respective cutting, or crimping, line relative to the frame is varied.

14. A cutting, or crimping, assembly according to claim 1 wherein the inlet conveyor and outlet conveyor are spaced apart, with the cutting, or crimping apparatus being disposed in a gap between the inlet conveyor and outlet conveyor so as to cut, or crimp, wrapping material between adjacent articles as they pass from the inlet conveyor to the outlet conveyor.

15. A cutting, or crimping, assembly according to claim 14 wherein the inlet and outlet conveyors are arranged to transport individual articles, or collations of articles, through the cutting, or crimping, apparatus along a conveyor longitudinal axis and the cutting, or crimping, apparatus is arranged such that the first and second jaw members are movable, and at least a portion of the inlet and outlet conveyors are movable such that the gap between them is movable with the first and second jaw members, in the direction of said conveyor longitudinal axis, as the first and second jaw members are moved relative to each other from the first axial position to the second axial position.

16. A cutting, or crimping, assembly according to claim 15 wherein the inlet and outlet conveyors each comprise a conveyor belt driven by a plurality of rollers, wherein a rear roller of the inlet conveyor and a front roller of the outlet conveyor, disposed on opposite sides of the gap, are movable in the direction of said conveyor longitudinal axis such that said gap is movable in the direction of said conveyor longitudinal axis.

17. A cutting, or crimping, assembly according to claim 15 wherein the first and second jaw members and/or the rear roller of the inlet conveyor and the front roller of the outlet conveyor are mounted on a carriage that is slidably mounted for movement in the direction of said conveyor longitudinal axis.

18. A cutting, or crimping, assembly according to claim 1 wherein the inlet and outlet conveyors are arranged to transport individual articles, or collations of articles, through the cutting, or crimping, apparatus along a longitudinal axis and the jaw members and frame are arranged such that the jaw members are movable between their first and second axial positions in a plane that is substantially perpendicular to said longitudinal axis.

19. A packaging apparatus comprising: a wrapping material applicator for wrapping an article, or a collation of articles in a wrapping material, an applicator inlet conveyor for transporting unwrapped articles towards the applicator; an applicator outlet conveyor for transporting wrapped articles away from the applicator; wherein the packaging apparatus further comprises a cutting, or crimping, assembly according to claim 1 arranged to respectively cut, or crimp wrapping material extending between adjacent articles, or collations of articles.

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